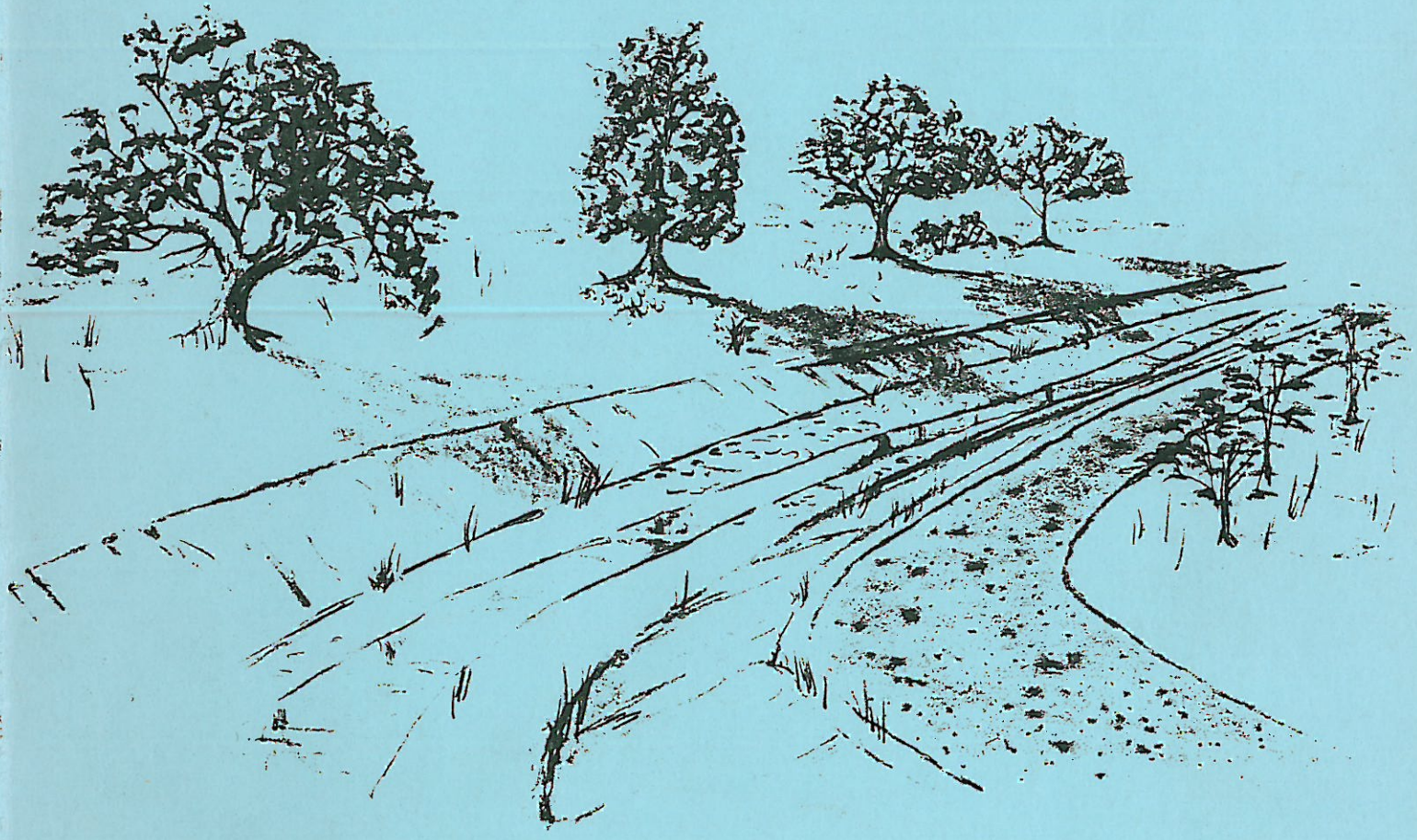
City of Antioch
Proposition 1E Grant Proposal
Attachment 3

Work Plan
N_pr 0 md 0

West Antioch Creek Improvements EIR (1984)

File: 4012-03

DRAFT ENVIRONMENTAL IMPACT REPORT FOR WEST ANTIOCH CREEK IMPROVEMENTS



INCLUDING:

ENGINEER'S REPORT — APPENDIX B

DRAFT ENVIRONMENTAL IMPACT REPORT
FOR
WEST ANTIOCH CREEK IMPROVEMENTS
(PW 83-122)

STATE CLEARINGHOUSE NUMBER SCH 84011013

Prepared for

Contra Costa County Planning Department
County Administration Building, North Wing
P. O. Box 951
Martinez, California 94553-0095

Prepared by

Darwin Myers Associates
2246 Morello Avenue
Pleasant Hill, California 94523

June 1984

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SUMMARY

The Contra Costa County Flood Control and Water Conservation District (CCCFCWCD) proposes drainage improvements to the lower reach of West Antioch Creek. The project area extends downstream from the Southern Pacific right-of-way to the brackish marsh along the south edge of the San Joaquin River. Mapping and Preliminary Mapping of the Federal Insurance Administration indicates that currently 108 acres are subject to inundation by the 100-year flood along the reach of the creek between the Southern Pacific and AT&SF rights-of-way. The proposed project would greatly reduce the frequency and extent of flooding along this reach of the West Antioch Creek.

The only significant area of controversy concerns the effect of the project on wildlife and vegetation, particularly in the brackish marsh area located north of the AT&SF Railroad. The primary issue to be resolved is the selection of a drainage improvement concept that can efficiently (and economically) move runoff through the lower portion of the watershed, and at the same time minimize disruption to wildlife and wildlife habitat, especially in the marsh.

The CCCFCWCD has considered two (2) basic alternatives: 1) a rectangular concrete channel, and 2) an earth channel with embankments having 2:1 (horizontal to vertical) side slopes. The analysis of the alternatives included detailed hydrologic studies, preparation of preliminary plans, estimates of construction and maintenance costs, and consideration of environmental values. The proposed project is the earth channel alternative. This alternative does include the use of a rectangular concrete channel where there is insufficient space for an earth channel, and a 4-barrel reinforced concrete box culvert is proposed where the creek is presently culverted.

The following is a summary of the significant environmental impacts that have been identified, along with potential mitigation measures.

A. Land Use

1. Future Development

Impact. The proposed improvements would be adequate to carry runoff if future development ties in with what is planned in the area. Significant expansion of the City into the hills south of the existing sphere of influence could lead to renewed flooding in the project area.

Mitigation Measure. Agricultural preserve contracts should be encouraged in the area south of the existing sphere of influence.

2. Fairgrounds Property

Impact. The proposed project would result in loss of approximately five (5) acres of parking on the County Fairgrounds property. Over the long-term, the loss of parking along with the increased value of the property because of the reduction in flood hazards, may hasten the day when a fairground use of the parcel will be considered obsolete.

Mitigation Measure. A parking study is recommended to maximize parking and provide for efficient circulation on the fairground property.

To avoid the potential for wasted land in the future, it is recommended that the location of the drainage right-of-way take into account the ultimate use of the fairground property.

B. Legal, Policy and Institutional Constraints

Impact. The proposed project has the potential to adversely affect the wildlife value of the lower reach of West Antioch Creek as well as the adjacent marsh area.

Mitigation Measure. The earth channel is considered more environmentally sensitive than a rectangular concrete channel. The project design includes a stilling/sedimentation basin to trap sediment that otherwise would have the potential to choke benthonic organisms and vegetation in the marsh area. Also, the project has an outlet pond to minimize the potential for erosion at the outfall of the stilling/sedimentation basin.

C. Traffic and Circulation

1. Detours

Impact. New culverts are required under 10th Street, and the channel crossing of Somersville Road is to be relocated. The proposed project would result in rerouting of traffic on 10th Street and Somersville Road during construction.

Mitigation Measure. The nearest alternate for Somersville Road traffic is 10th Street and vice versa. Therefore, the drainage improvements within the right-of-way of one of these roads should be completed and the road reopened prior to commencing construction on the other crossing.

2. Louisiana-Pacific

Impact. As proposed, construction of the stilling/sedimentation basin would eliminate a private road that links the LP Corporation with the Glass Container Corporation.

Mitigation Measures. Possible alternatives include a) construction of a bridge across the concrete channel immediately

upstream from the stilling/sedimentation basin, and b) construction of a road adjacent to and south of the AT&SF right-of-way without reducing the volume or effectiveness of the stilling/sedimentation basin.

If the plant operations of LP Corporation and Glass Container Corporation were modified, it is conceivable that the need for a road connection could be eliminated.

D. Geology, Soils and Earthwork

1. Embankments

Impact. Much of the material north of the AT&SF Railroad may be unsuitable for use in constructing embankments and engineered fills. The earth materials in the stilling/sedimentation basin are marginally suited for such uses. Elsewhere in the project, earth materials are suited to the intended use.

Mitigation Measure. The earth embankments in the project would be constructed in accordance with accepted standards. Because the material north of Somersville Road may be unsuitable for use in embankments, or would require special treatment, it is recommended that a soil engineer analyze subsurface conditions in the stilling/sedimentation basin and outlet pond to determine the suitability of the material which is to be excavated.

2. Engineered Fill

Impact. The proposed project will generate more fill than can be utilized within the drainage right-of-way. Fill utilized in the construction of berms within the channel right-of-way would be placed in accordance with Public Works standards. The standards guiding emplacement of fills outside the channel right-of-way are less clear. According to the CCCFCWCD, the earthwork outside the channel right-of-way would be subject to building inspection regulations.

Mitigation Measure. All fills should be designed and compacted in accordance with their planned use. If fill material is to be placed outside the channel right-of-way, grading permits should be secured from the local jurisdiction. The material should be emplaced under the direct supervision of a soil engineer, in accordance with the recommendations of the soil engineer's report and the grading regulations of the jurisdiction (Grading Ordinance, or Chapter 70, UBC).

E. Hydraulics

1. Scour and Erosion

Impact. In segments of the project where there is an abrupt

change in the alignment of the channel, scour of the "outside" bank is a potential hazard.

Mitigation Measure. The project design includes a concrete lining where hydraulic analysis indicates that velocities would be high enough to produce scouring of an earth channel. In those bends where a concrete lining would not be required, we recommend the use of erosion control plantings. Hydroseeding with annual grasses would not be considered adequate for erosion control in such areas. Deeper rooted vegetation should be considered (brush and trees), with preference given to native riparian species.

F. Vegetation and Wildlife

1. Short-Term Effects

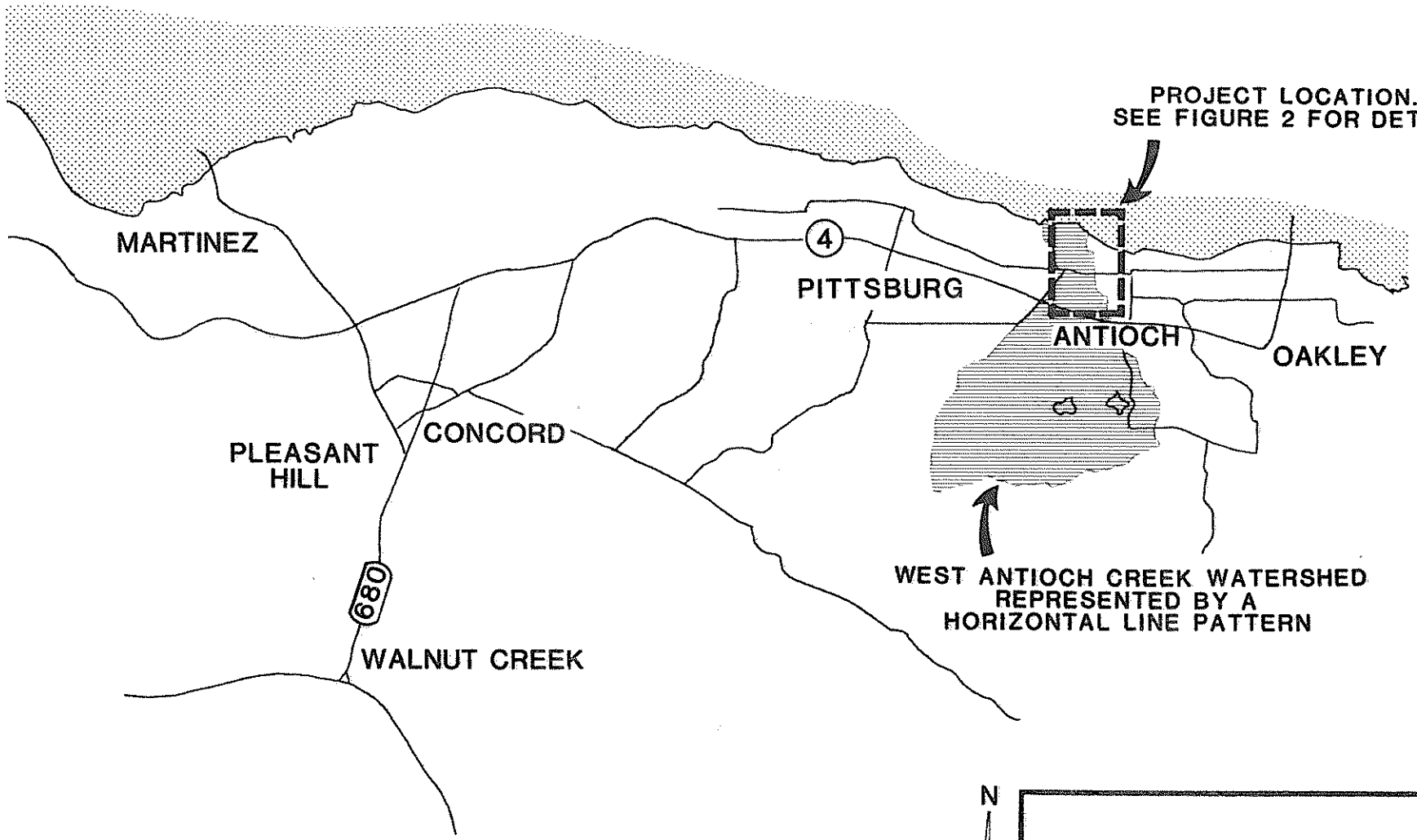
Impact. All existing vegetation and the wildlife it supports would be eliminated by earthwork in the project area. The construction of the outlet pond would also pose the potential to disrupt the nesting of birds, especially the long-billed marsh wren.

Mitigation Measure. To minimize disruption to birds nesting in the marsh area, work north of the AT&SF trestle should be delayed as late into the construction season as possible.

2. Long-Term Effects

Impact. Long-term effects are dependent on two (2) factors: a) the frequency and extent of maintenance activities along the creek, including the cleaning of sediment from the stilling-sedimentation basin and the outlet pond, and b) the type and extent of landscaping which would be provided as part of the project.

Mitigation Measure. Disturbance of the marsh can be kept to a minimum by controlling the movement of maintenance equipment, especially that used in maintenance of the outlet pond. The plans prepared by CCCFCWCD show a bench (maintenance road) on the south side of the outlet pond, adjacent to the AT&SF right-of-way. Because of its elevation (+5 feet) the bench would be overtopped during episodes of high runoff on the Sacramento-San Joaquin Rivers. In the design of the project, it is recommended that consideration be given to means of controlling erosion of the bench during floodflows on the river. Use of a rock fill would be one means of controlling such erosion.



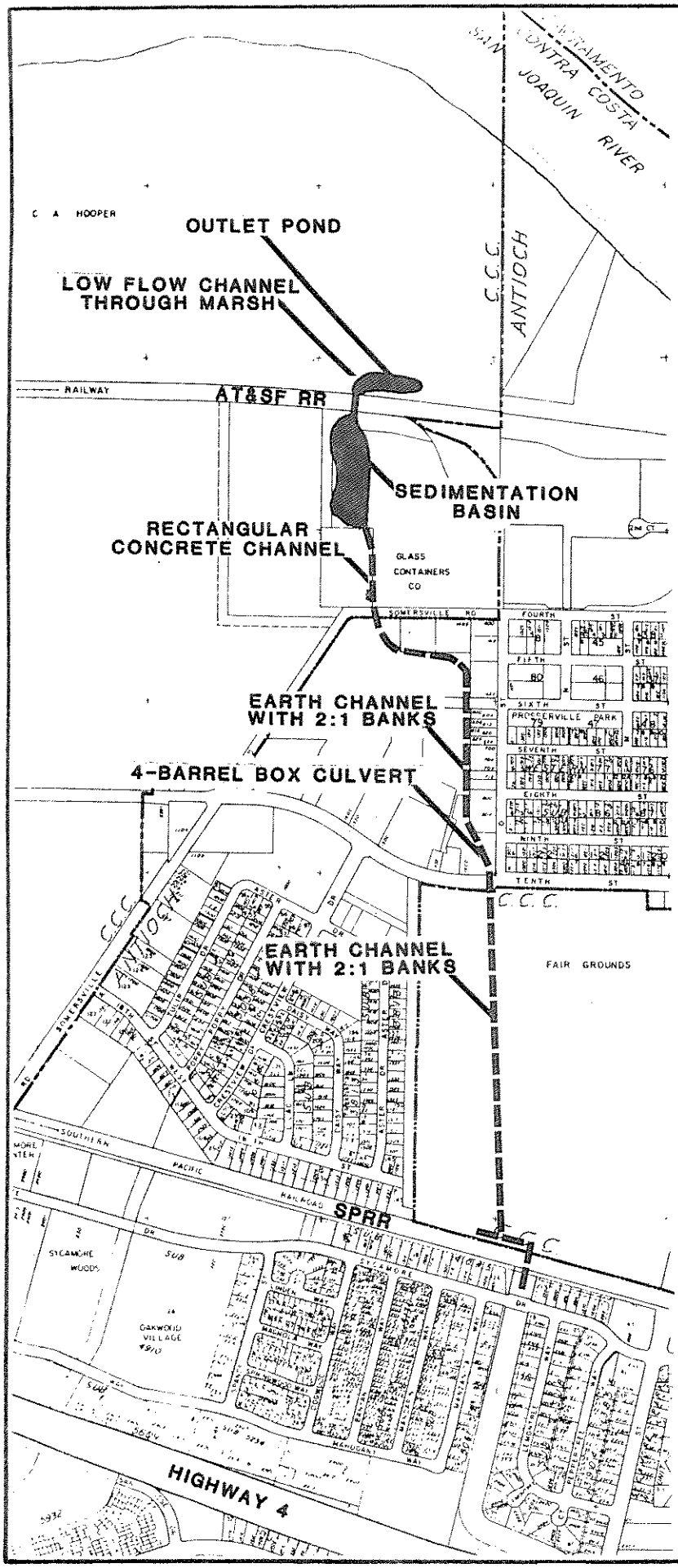
VICINITY MAP

SCALE: 1"=3MI

DATE: MAY, 1984

FIGURE 1

WEST ANTIOCH CREEK IMPROVEMENTS
CONTRA COSTA COUNTY FILE# PW83-122



EXPLANATION

The downstream end of the project is located in the brackish marsh area on the north side of the Atchinson, Topeka & Santa Fe Railroad right-of-way. The project extends south from the AT&SF railroad approximately 1,100 feet, where it crosses Somersville Road. At this point, the channel swings approximately 500 feet to the east and then resumes its southward trend for 800 feet. The channel then jogs to the east and crosses the 10th Street right-of-way. At this point, the channel is immediately west of the "O" Street right-of-way. The channel then extends southerly across the Contra Costa County Fairgrounds to a point just north of the Southern Pacific Railroad right-of-way. The channel then jogs east for 240 feet, parallel to the Southern Pacific right-of-way. At this point, the project crosses the Southern Pacific right-of-way to the inlets to the proposed system. The project also includes improvements to a 100-foot segment of Markley Creek at its confluence with West Antioch Creek.

PROJECT LOCATION MAP

SCALE: 1"=900'	FIGURE 2
DATE: MAY, 1984	

WEST ANTIOCH CREEK IMPROVEMENTS
CONTRA COSTA COUNTY FILE# PW83-122

frictional drag that occurs along the boundary of an earth channel. At the time that the "Notice of Preparation" was completed, the preferred alternative was the rectangular concrete channel. However, as the details of the design were completed, it was determined by the Flood Control District that an earth channel would be environmentally superior, and that it would be less costly to construct. At that point a decision was made to amend the project description, from a concrete channel to an earth channel. This Draft Environmental Impact Report evaluates the proposed earth channel project. The rectangular concrete channel is presented as a project alternative.

B. Identification of Area Subject to Flooding

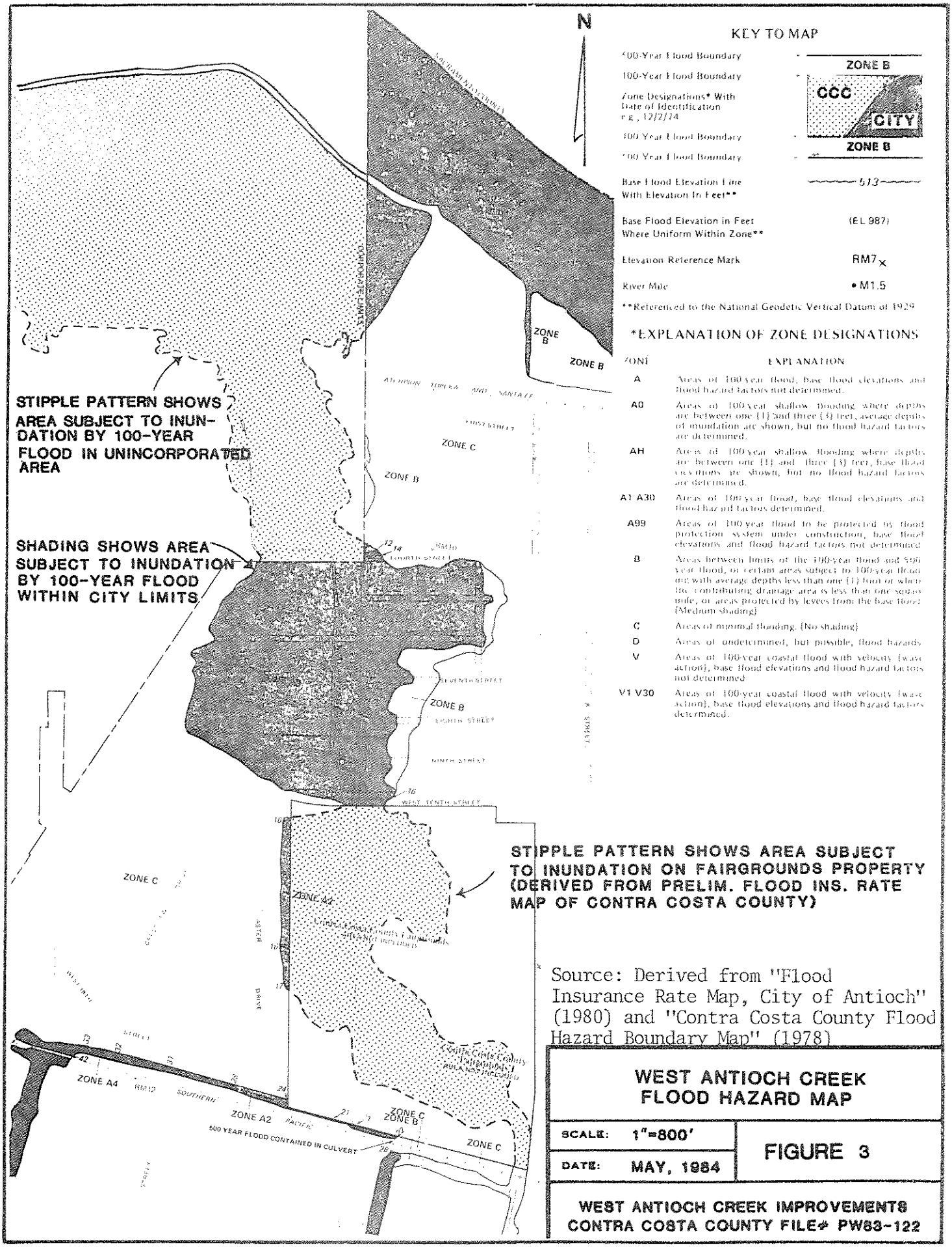
Studies have been performed by the Federal Insurance Administration which established the extent of the area subject to flooding along West Antioch Creek. Figure 3, West Antioch Creek Flood Hazard Map, is derived from 1983 Preliminary Work Maps showing areas subject to inundation in the unincorporated area, and the "Flood Insurance Rate Maps" issued to the City of Antioch (dated 12/2/80).

Figure 3 indicates that currently 108 acres are subject to inundation by the 100-year flood in the portion of the watershed between the Southern Pacific and Atchison Topeka and Santa Fe railroads. With continued development, the size of the affected area can be expected to increase unless measures are undertaken to increase the capacity of the channel. In this regard, it is pertinent to note that a 300-unit phase of the Mira Vista Hills subdivision is under construction in the foothills area (see Figure 4, View A). Additionally, there are relatively large, undeveloped parcels within the watershed that are planned for development which have utilities available in the adjacent streets (see Figure 4, View B). It can be anticipated that these lots would be built on during the 1980's, further aggravating the flooding problem.

C. County Service Area D-3

In 1970, the Board of Supervisors passed Resolution #70/452 establishing County Service Area D-3. The boundary of the service area was drawn to encompass the watershed of West Antioch Creek, including the Markley Creek subwatershed. As such, it includes the westerly portion of the City of Antioch, along with several square miles of unincorporated land in the hills northwest of the City. Figure 5 is a U.S. Geological Survey topographic map that shows the areal extent of the West Antioch Creek watershed. It also shows the location of intermittent and perennial streams within the watershed.

The Flood Control District prepared an Engineer's Report for County Service Area D-3 (dated May, 1971). That report recognized the severity of the flood hazard which existed within

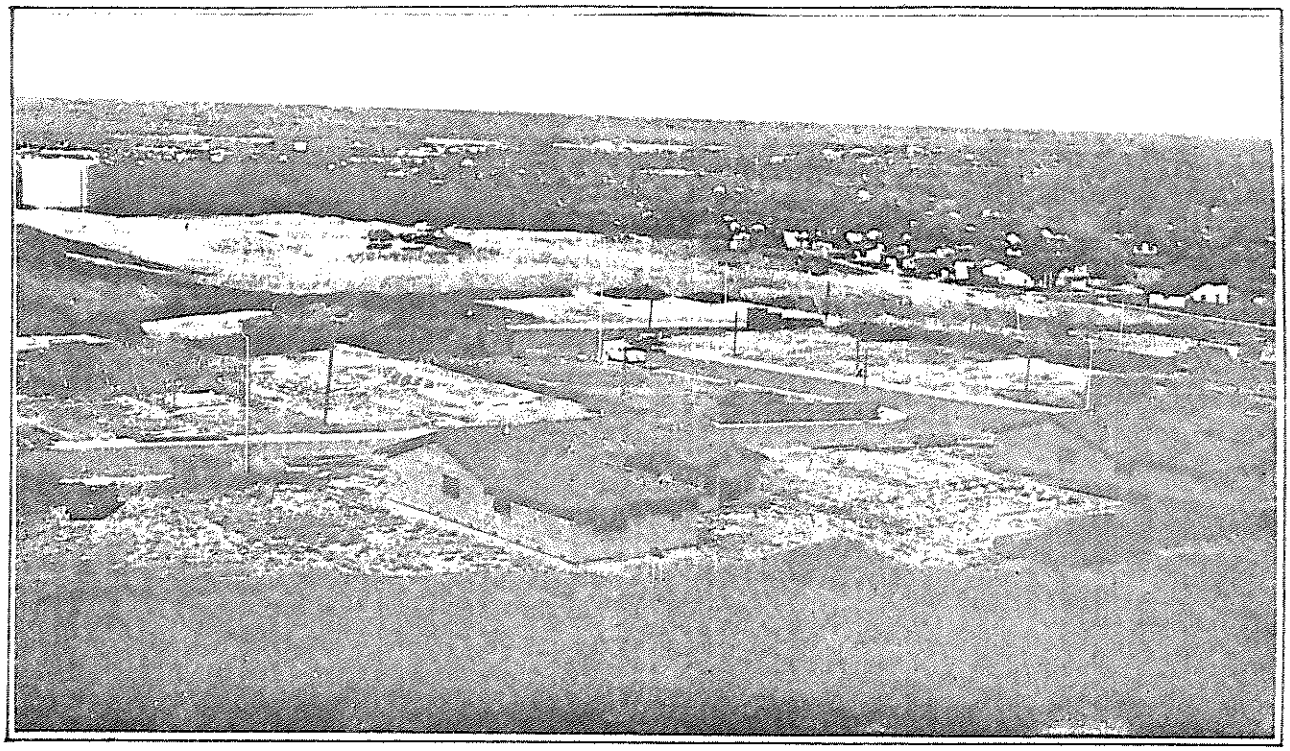


Source: Derived from "Flood Insurance Rate Map, City of Antioch" (1980) and "Contra Costa County Flood Hazard Boundary Map" (1978)

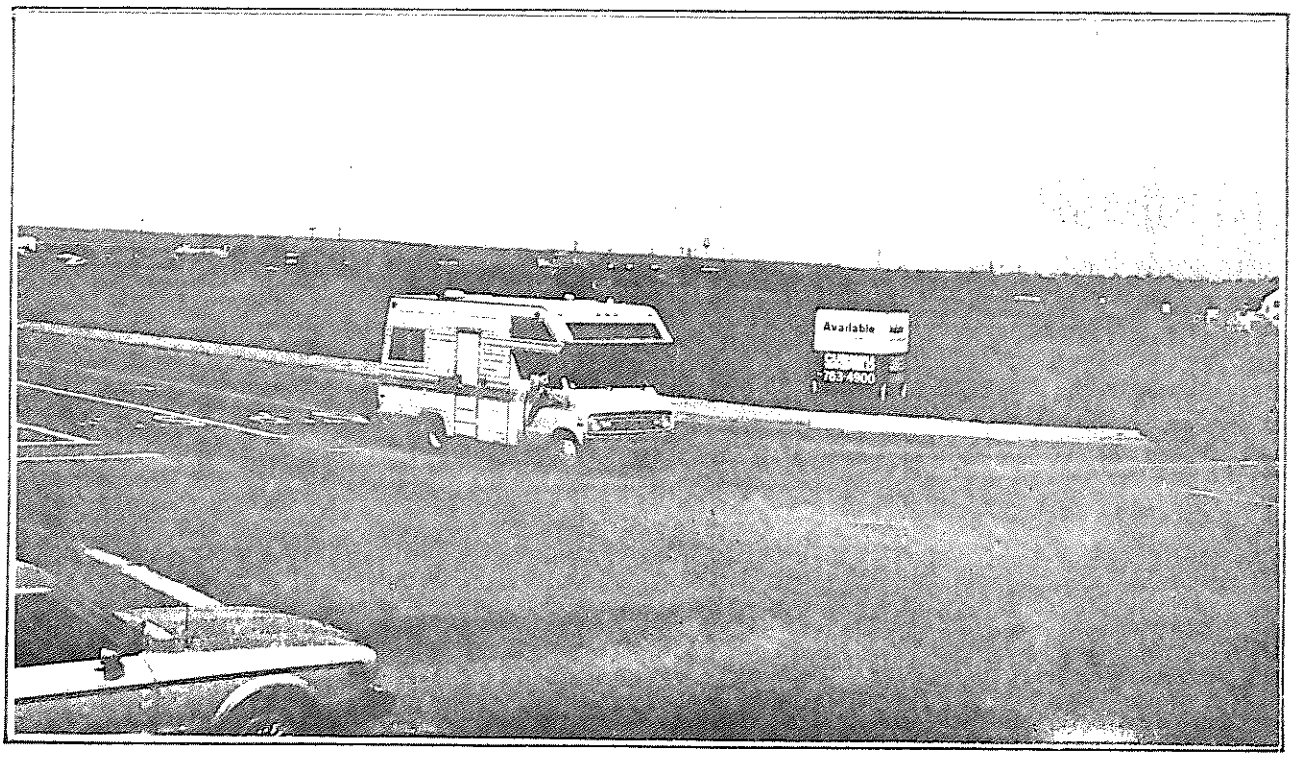
WEST ANTIOCH CREEK FLOOD HAZARD MAP

SCALE: 1"=800'	FIGURE 3
DATE: MAY, 1984	

WEST ANTIOCH CREEK IMPROVEMENTS
CONTRA COSTA COUNTY FILE# PW83-122



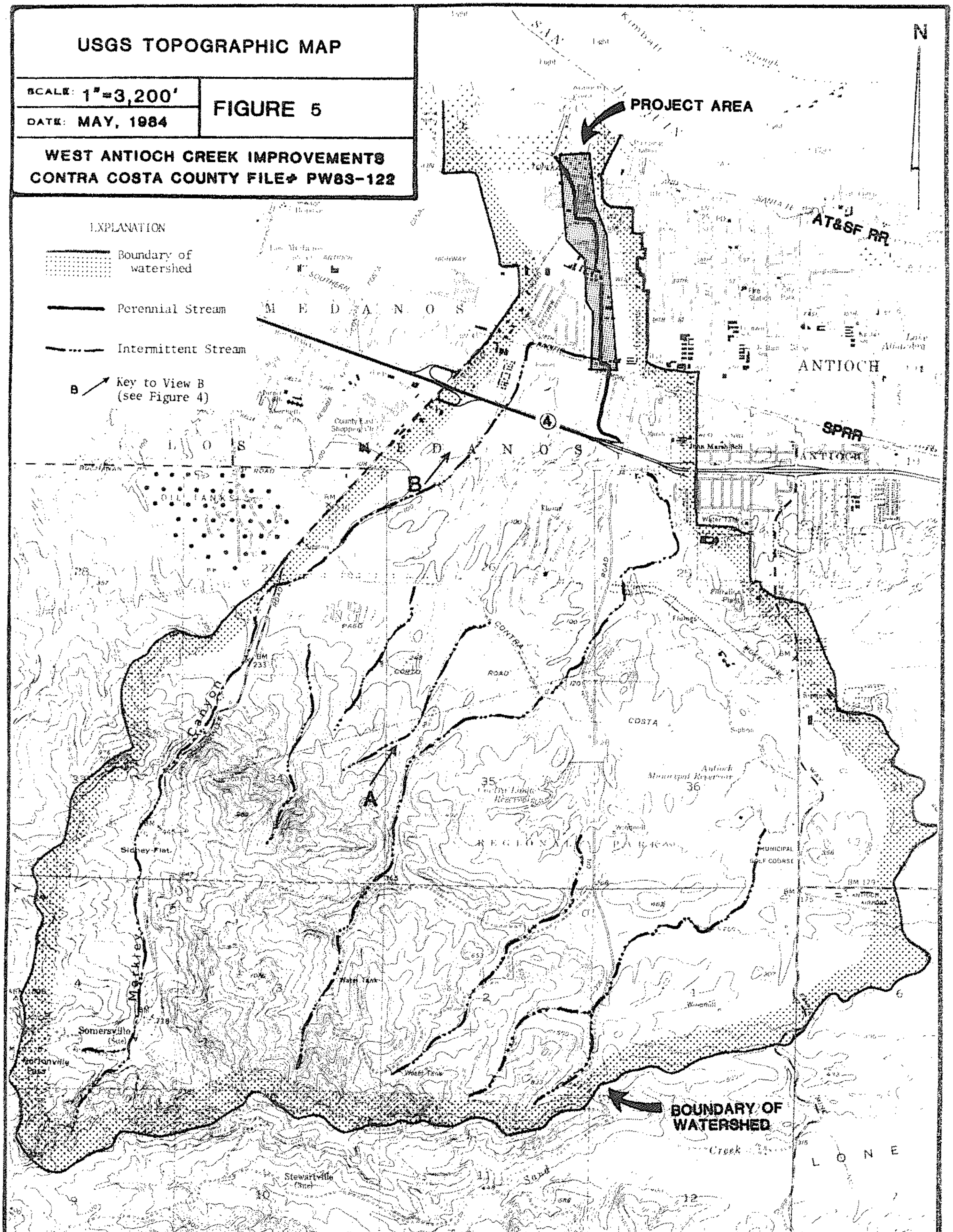
View A. Construction of Homes, Mira Vista Hills Subdivision



View B. Vacant Parcel With Recently Posted Sign; northeast corner of Delta Fair Boulevard and Buchanan Road

SEE FIGURE 5 FOR KEY TO VIEWS

VIEWS A AND B	MAY, 1984	FIGURE 4
	CONTRA COSTA CO FILE# PW83-122	


USGS TOPOGRAPHIC MAP
SCALE: 1"=3,200'
DATE: MAY, 1984
FIGURE 5
WEST ANTIOCH CREEK IMPROVEMENTS
CONTRA COSTA COUNTY FILE# PW83-122
EXPLANATION
Boundary of watershed
Perennial Stream
Intermittent Stream
B Key to View B (see Figure 4)
N
PROJECT AREA
AT&SF RR
SPRR
ANTIOCH
M E D A N O S
L O S M E D A N O S
OIL TANKS
CONTRA COSTA
REGIONAL PARK
Canyon
Markley
Sidney Flat
Somersville (Site)
Nortonville Pass
Stewartville (Site)
Water Tank
Antioch Municipal Reservoir
MUNICIPAL GOLF COURSE
A
B
BOUNDARY OF WATERSHED
L O N E
Creek
Sand

the West Antioch Creek watershed. Specific problems that were identified in the service area included the following:

1. Direct damage from flood waters to residential, commercial and industrial land and improvements, and to personal property.

2. Ponding of polluted flood waters in or adjacent to populated areas.

3. Outflow of raw sewage from sanitary sewers due to the infiltration of flood waters into these sewers.

4. Loss of vital public utilities during periods of high water.

5. Damage to and failure of public and private bridges and culverts due to their inadequacy, or their obstruction by debris lodging against them.

6. Damage to and failure of public streets, roads and highways.

The Engineer's Report also identified the following adverse effects of floods and poor drainage within the service area:

1. Depressing effect upon property values in the entire community.

2. Hazard to the public health of the community.

3. Hazard to traffic from excess storm water on public streets, roads and highways; also, the hazard and inconvenience to pedestrians (including schoolchildren) who necessarily use such public thoroughfares.

4. Possible disruption of important highway and rail traffic.

5. Increased maintenance costs for public and private transportation facilities.

6. Discouragement of the development of lands within the zone to a higher use, because of actual flood conditions requiring expensive contruction to provide adequate protection against flooding and inundation.

The report further recommended improvements to West Antioch Creek from the San Joaquin River upstream to the Mokelumne Aqueduct, a distance of about 13,700 feet, and improvement plans were referenced. The Engineer's Report also identified possible means of funding the improvements. Subsequently, Ordinance #71-83 was enacted, and it established an

acreage fee of $400/acre, to be paid only once, as properties were developed in the watershed. In 1980, the drainage fee was increased to $1,600/acre. The funds on hand to make drainage improvements within County Service Area D-3 total $198,974 as of March 15, 1984.

D. Proposed Project

The Flood Control District proposes channel improvements of the segment of West Antioch Creek from the marshy area north of the Atchison Topeka and Santa Fe Railroad (AT&SF) to the south side of the Southern Pacific Railroad right-of-way, a distance of approximately 6,000 feet (see Figure 2). The planned improvements are presented in the accompanying Engineer's Report at a scale of 1 inch = 160 feet (see Appendix B, Exhibit C).

The Engineer's Report also provides a detailed description of the plan elements, along with a discussion of projected costs. The plan elements are briefly summarized in Table I. The following discussion is intended to provide an overview of the proposed project.

1. Objectives. The main objective of the proposed improvements is to prevent uncontrolled flooding of the segment of West Antioch Creek that is north of the Southern Pacific right-of-way. The project is designed to carry the peak discharge from the 100-year and 50-year storm with approximately 1 foot and 2 to 3 feet of freeboard respectively. A second objective is to control the release of sediment into the marsh, and to prevent scour of the marsh area during episodes of heavy runoff.

2. Design Criteria. The design assumes a water surface at the mouth of West Antioch Creek of 6.5 feet. This was considered conservative since the high tide in this area has exceeded 6 feet only twice since 1947.

3. Preferred Alternative. The Flood Control District considered a rectangular concrete channel and a trapezoidal earth channel with 2:1 (horizontal to vertical) banks. The earth channel is preferred because it is a) cost effective, and b) environmentally superior.

4. Outlet Pond. North of the AT&SF right-of-way, an outlet pond is proposed which would have a length of 400 feet and a bottom width of 50 feet$^{\pm}$. The outlet pond would be excavated about 3 feet deep into the marsh area. Its northerly bank would be at the level of the marsh and its southerly bank would rise to the AT&SF Railroad right-of-way. The pond would act as a broad-crested weir, dispersing runoff into the marsh at low velocities in order to minimize impacts on the marsh

TABLE I
SUMMARY OF PROPOSED IMPROVEMENTS, WEST ANTIOCH CREEK

LIMITS	EXISTING SETTING	PROPOSED PROJECT	ALTERNATE CHANNEL (CONCRETE CHANNEL)
North of AT&SF RR.	Marsh	Outlet pond w/weir, outlet to low-flow channel.	Same as proposed project
AT&SF RR.	Timber RR. Trestle	No change	No change
From AT&SF RR to Somersville Road	Narrow earth channel w/bridge at Somersville Road	Stilling/sedimentation basin south of AT&SF RR. Concrete channel from Station 12+10 to 17+46/ bottom width 68 feet.	Same as proposed project but with bottom width of 50 ft. from Station 12+10 to 17+46.
Somersville Road	Bridge	4 barrel 15'x 7' reinforced concrete box (RCB)	4 barrel 15' x 8' reinforced concrete box (RCB)
South side of Somersville Road to 8th Street	Natural channel (see Fig. 14, View G)	Trapezoidal earth channel; bottom width 90'.	50' wide rectangular concrete channel
8th St. to south side of 10th St.	Concrete channel with twin 84" CMP under 10th St. (see Fig.14, View H; Fig. 15, View I).	4 barrel 14' x 7' RCB	4 barrel 12' x 7' RCB
South of 10th St. to Markley Creek	Earth channel; top width 50' (see Fig. 15, View J).	Trapezoidal earth channel; bottom width 80'.	40' wide rectangular concrete channel.
From Markley Creek southeasterly to crossing under SPRR.	Earth channel	Trapezoidal earth channel; bottom width ranges from 80' to 34'.	28' wide rectangular concrete channel
SPRR	96" reinforced concrete pipe	Triple 96" RCP extending under the RR to proposed inlets to the south	Same as proposed project
Markley Creek	Earth channel ~15' top width	Trapezoidal earth channel; bottom width 10'.	10' wide rectangular concrete channel

and eliminate the need for an outfall channel through the marsh.

During periods of low flow, surface waters released from the outlet pond would be carried by the existing low flow channel to the San Joaquin River. During flood flows, water released from the outlet pond would sheetflow across the brackish marsh to the San Joaquin River.

5. Stilling/Sedimentation Basin. A fundamental element of the design is a stilling/sedimentation basin that is to be located south of the AT&SF right-of-way. This basin would be 640 feet long and possess a bottom width of 80 to 120 feet. The banks would be 7½ feet high and have slope gradients of 3:1 (horizontal to vertical). This basin is intended to reduce the volume of sediment conveyed into the marsh area.

6. Channel Alignment. The improved channel will generally follow the existing creek alignment, with one notable exception. It is to be realigned in the vicinity of Somersville Road. This realignment is necessitated by physical constraints imposed by existing development. Minor realignment is also planned north of 10th Street to avoid two 90 degree bends in the channel between stations 32+00 and 36+00 (see Appendix B, Exhibit C).

E. Aerial Photographs and Sections

To aid in visualizing the project, the proposed earth channel has been plotted on an aerial photograph (scale 1"=400'). The top-of-bank is represented by a heavy black line (see Figures 6 and 7). To enhance readability, streets in the vicinity of the project are labeled, along with some buildings. Figures 6 and 7 also show lines of section for a series of representative cross-sections that are presented in Figures 8, 9 and 10. The sections, which have been labeled A through I extend from the downstream end of the project southward to the Southern Pacific Railroad.

With regard to the sections, areas of proposed cut are represented by a shaded pattern; areas of proposed fill are represented by a diagonal line pattern; and concrete structures are represented by a heavy black line. Following is a brief summary of the features shown on Figures 6 through 10.

Figure 6. The north limit of the project is approximately 1,300 feet south of the San Joaquin River. The intervening marsh area contains a low flow channel that conveys West Antioch Creek runoff through the marsh area to the San Joaquin River. A large pond is located in the marsh, 700 feet$^{\pm}$ north of the project. The presence of these waterways

Source: Pacific Aerial Surveys
Date: 5-18-82
Photo#: AV-2145-03-10

N

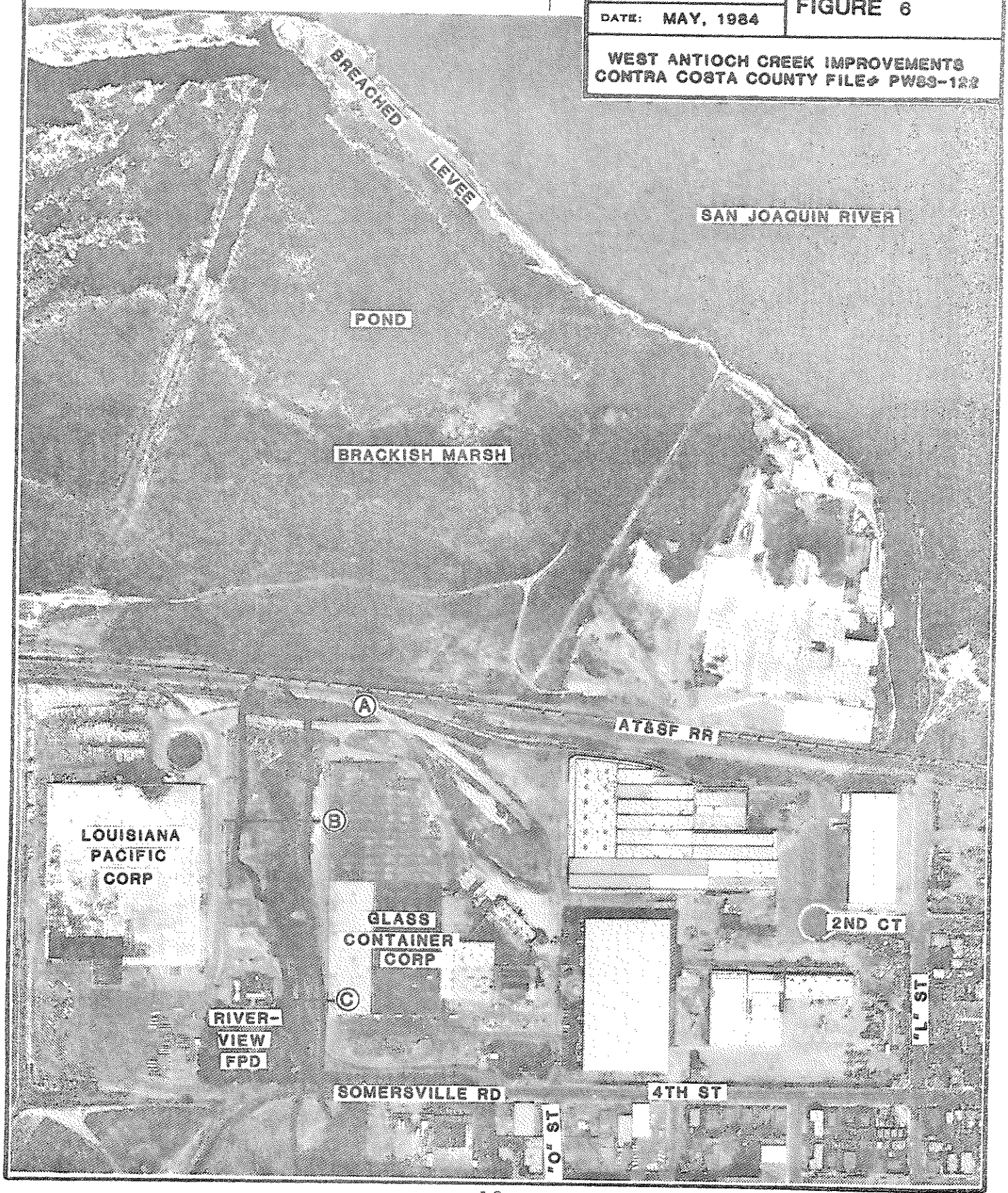
AERIAL PHOTO OF PROJECT AREA (NORTH HALF)

SCALE: 1"=400'

DATE: MAY, 1984

FIGURE 6

WEST ANTIOCH CREEK IMPROVEMENTS
CONTRA COSTA COUNTY FILE# PW83-122



enhances the value of the marsh as a wildlife habitat. It should be recognized that the marsh area supports a wide variety of amphibians, reptiles, birds and mammals. Perhaps the most notable are the birds, particularly waterfowl.

Note the location of the Riverview Fire Protection District (FPD) administrative offices in relationship to the proposed channel. The top-of-bank would encroach within approximately 100 feet of the structure. Virtually all of the mature trees along the east property line would be removed by the project.

Figure 7. The location of the proposed channel is traced from the immediate vicinity of Somersville Road to the Southern Pacific Railroad. The Princess Apartments and County Fairgrounds are labeled. Note that the proposed channel is approximately 400 feet from the west boundary of the 75-acre fairgrounds property.

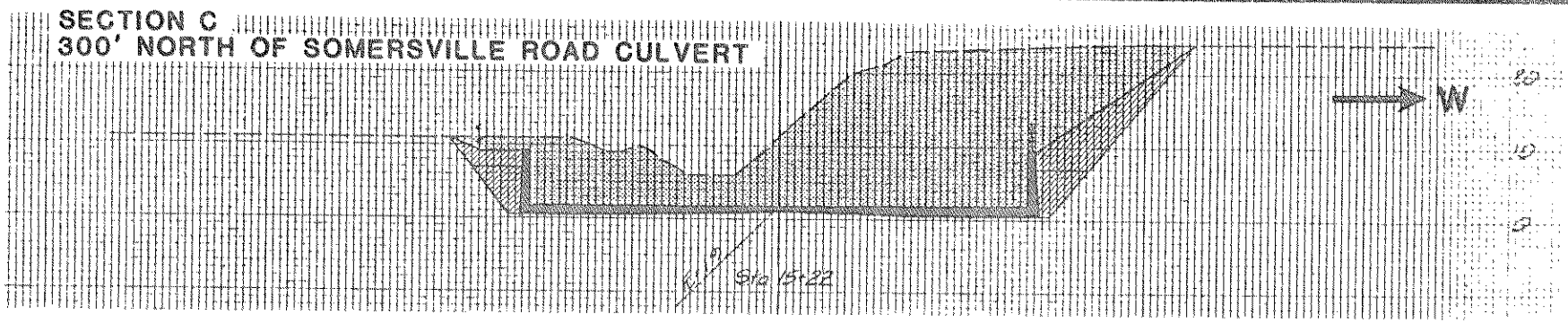
Figure 8. Section A indicates that the outlet pond would be 3 feet deep (i.e. 3 feet below the depth of the adjacent marsh area), with a bottom width of 50 feet. The banks of the outlet pond would possess a gradient of 4:1 (horizontal to vertical), or flatter. Note that berms would not be constructed on the north side of the pond; space is provided for a maintenance road along the south side of the pond, adjacent to the AT&SF right-of-way.

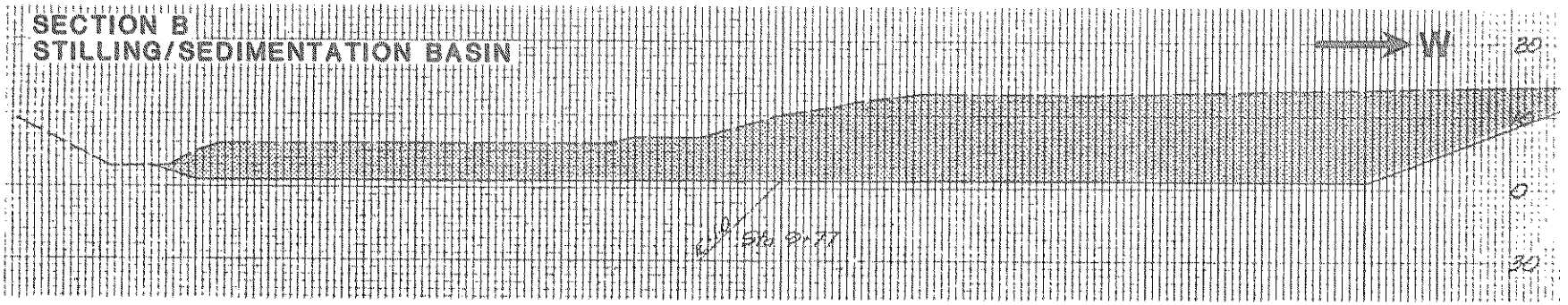
Section B indicates that grading for the stilling/sedimentation basin would involve cuts up to 14 feet in depth. The floor of the basin would be at elevation +1 foot (mean sea level datum), and the earth banks would have a gradient of 3:1.

Section C shows proposed improvements in the reach of the channel that is east of the Riverview FPD property. Because of space limitations, a rectangular concrete channel is required in this area. The top of the concrete channel would be at elevation +9.5 feet. On the west bank, overlooking the concrete channel, a 13½ foot high 2:1 fill slope is proposed. The top of slope would be 40 feet closer to the existing building on this property than the existing slope.

Figure 9. Section D indicates that the proposed improvements would utilize all of the existing right-of-way (which is labeled) and that additional right-of-way would be required along the west and south boundaries of the existing easement. The section indicates that the channel would have banks that are 7½ feet high. A maintenance road is proposed on the west bank at elevation +11 feet and on the east bank at elevation +6½ feet. A low concrete retaining wall is proposed at the top of slope along the east boundary of the drainage right-of-way.


Source: Pacific Aerial Surveys
Date: 5-18-82
Photo#: AV-2145-03-10
N
AERIAL PHOTO OF PROJECT AREA
(SOUTH HALF)
SCALE: 1"=400'
DATE: MAY, 1984
FIGURE 7
WEST ANTIOCH CREEK IMPROVEMENTS
CONTRA COSTA COUNTY FILE# PW83-122
SOMERSVILLE RD
PRINCESS APTS
"O" ST
8TH ST
10TH ST
10TH ST
CRESTVIEW DR
COUNTY FAIR-GROUNDS
COUNTY FAIRGROUNDS
"L" ST
SPRR
SYCAMORE DR
D
E
F
G
H
I



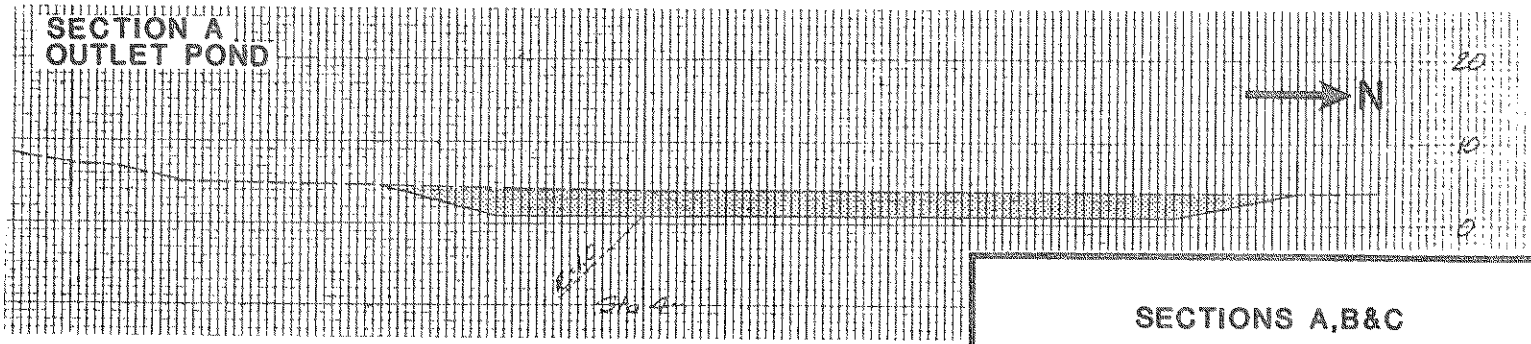


EXPLANATION

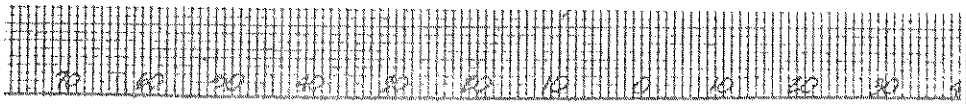
Cut

Fill

Concrete structures



For lines of section, see Figure 6.



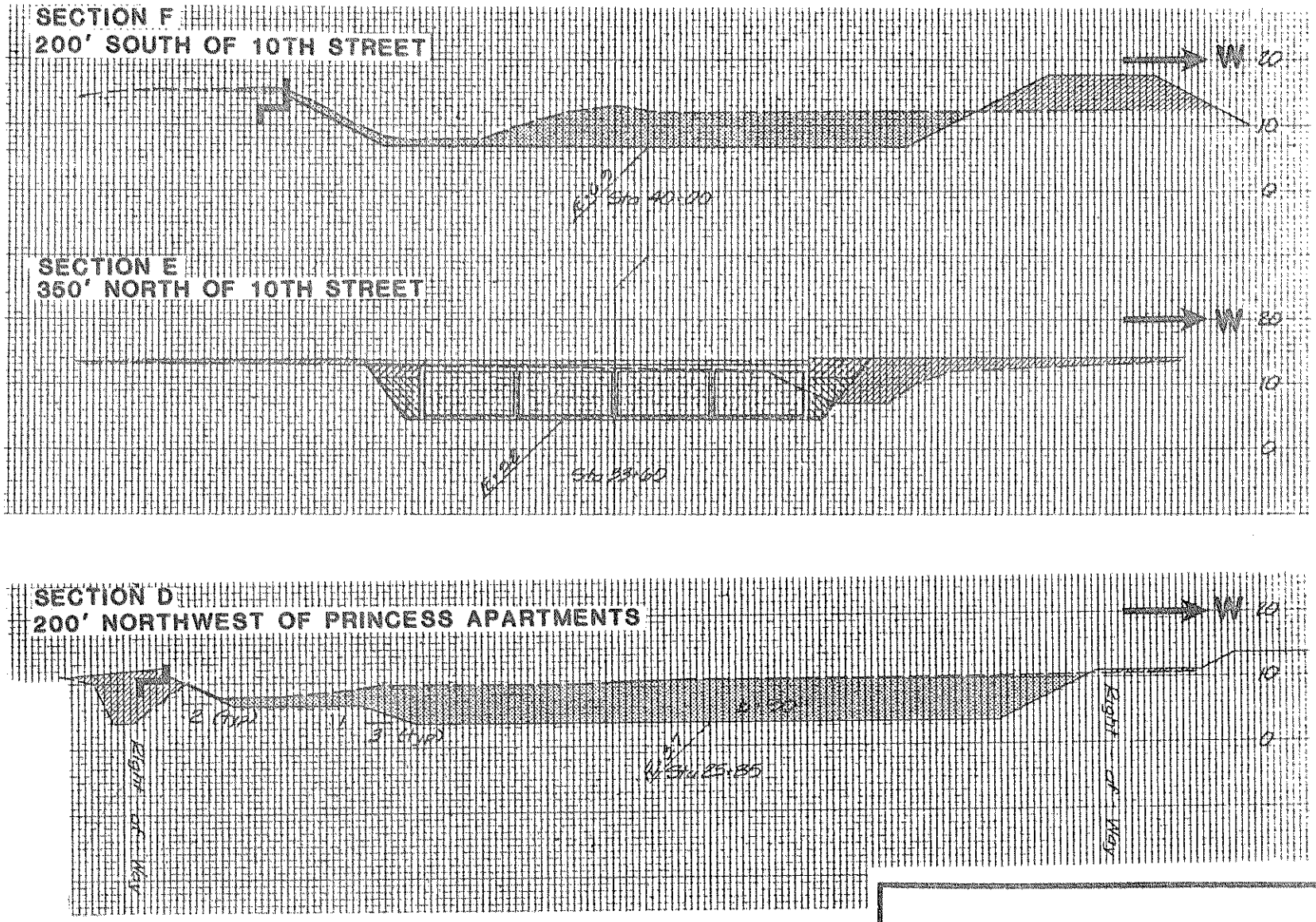
SECTIONS A,B&C

SCALE: 1"=24'

DATE: MAY, 1984

FIGURE 8

WEST ANTIOCH CREEK IMPROVEMENTS
CONTRA COSTA COUNTY FILE# PW83-122



See Figure 8
for explanation

See Figure 7
for lines of
section

SECTIONS D,E&F

SCALE: 1"=24'

DATE: MAY, 1984

FIGURE 9

WEST ANTIOCH CREEK IMPROVEMENTS
CONTRA COSTA COUNTY FILE# PW83-122

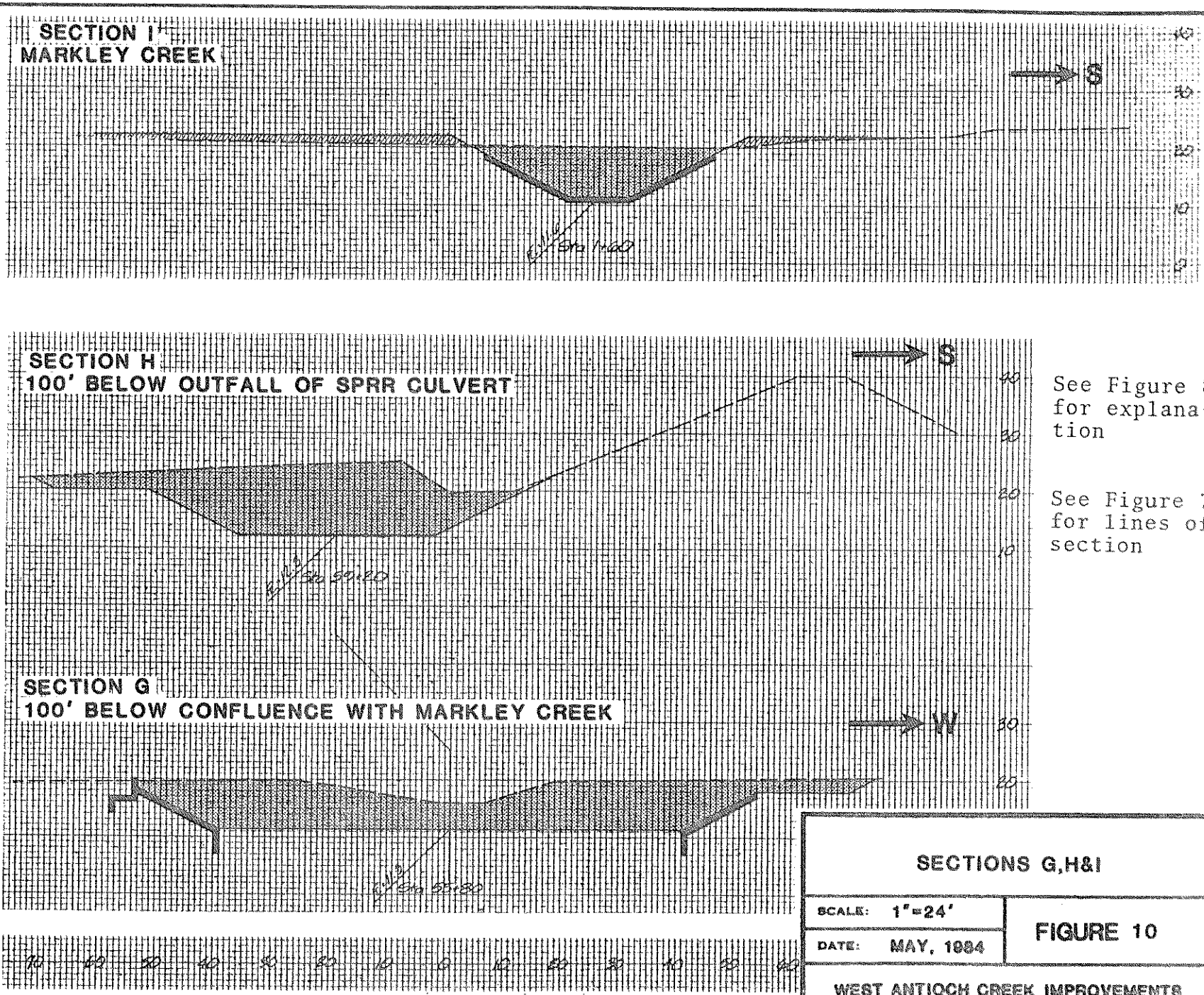
Section E shows a four-barrel concrete box culvert. The top of the culvert would be at elevation +13 feet. The floor of the channel would be at elevation +5 feet.

Section F shows the configuration of the channel on the County Fairgrounds property. In the section, the floor of the channel is at elevation +6½ feet and the banks have gradients of 2:1. A low concrete floodwall is proposed at the top of bank along the east boundary of the channel, and an earth berm with a crest elevation of +18 feet is proposed along the west bank.

Figure 10. Section G indicates that in this reach the channel sides would have concrete linings that possess a gradient of 2:1. The floor of the channel is at elevation 11.5 feet and the bottom width is 80 feet. A maintenance road is shown at elevation +18 feet along the west bank. A low floodwall is shown at the top of bank along the east side of the channel. Maintenance access on the east side of the channel could be attained from the existing roadway located immediately east of the proposed wall.

Section H shows the proposed channel with a depressed maintenance road on the north bank at elevation +20 feet. The topography south of the channel shows the Southern Pacific Railroad embankment with the tracks at elevation +40 feet.

Section I shows the proposed tie-in of Markley Creek with West Antioch Creek improvements. The section shows a trapezoidal-shaped concrete channel on Markley Creek with banks possessing a gradient of 2:1 (horizontal to vertical) and a bottom width of 10 feet. The floor of the channel is at elevation +11 feet and the top-of-bank at elevation +22 feet. Concrete extends to elevation +19 feet only; above that elevation, earth banks are proposed.



See Figure 8 for explanation

See Figure 7 for lines of section

SECTIONS G,H&I

SCALE: 1"=24'

DATE: MAY, 1984

FIGURE 10

WEST ANTIOCH CREEK IMPROVEMENTS
CONTRA COSTA COUNTY FILE# PW83-122

F. Hydrology

Introduction

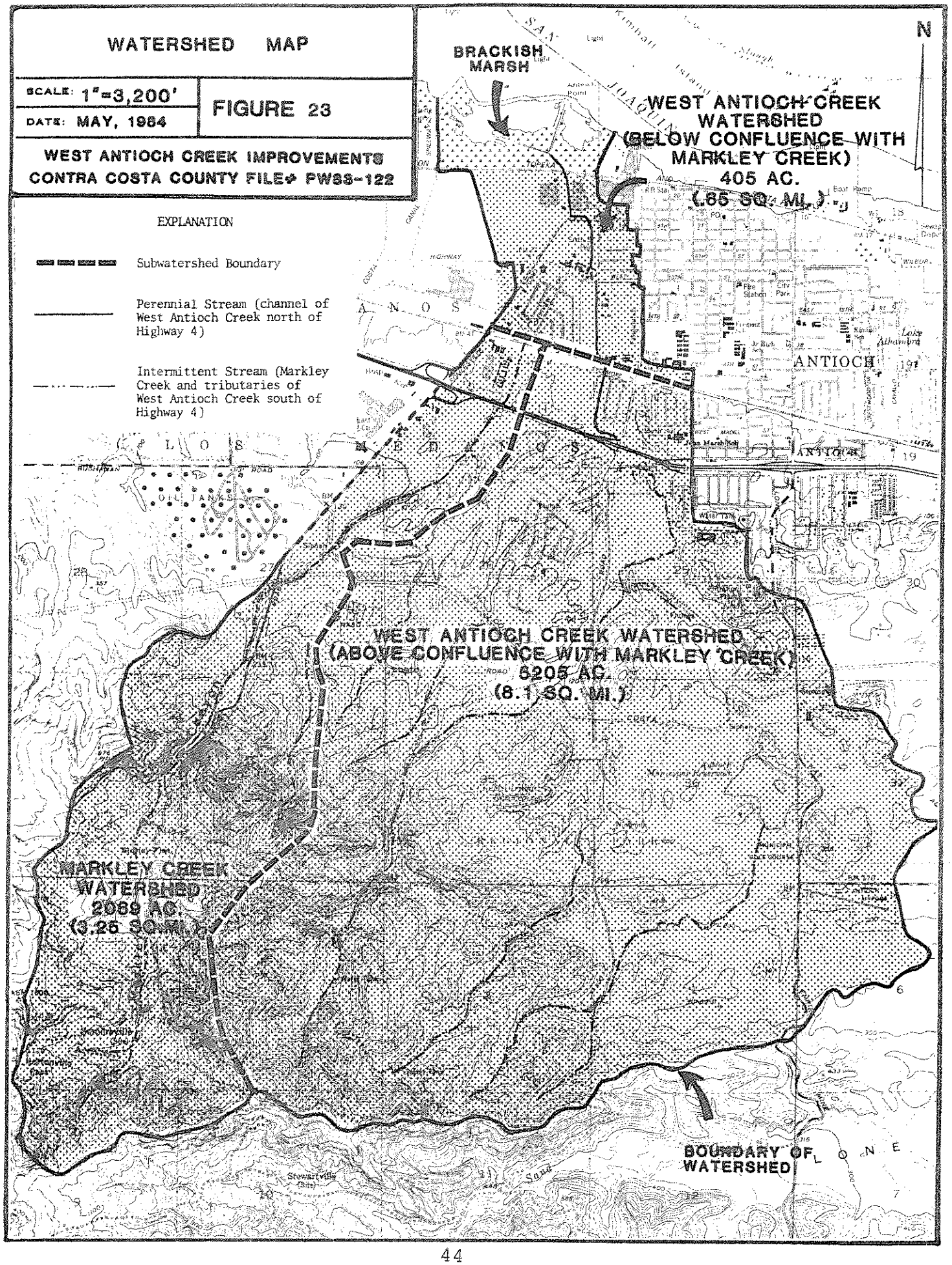
The U.S. Geological Survey's Antioch North and South 7.5 Minute Quadrangle maps are the base for Figure 23. This base map classifies West Antioch Creek as a perennial stream north of Highway 4. All tributaries and water courses south of Highway 4 are classified as intermittent streams. The volume of surface runoff carried by the channel during the summers is low, and is believed to consist chiefly of irrigation water from developed properties.

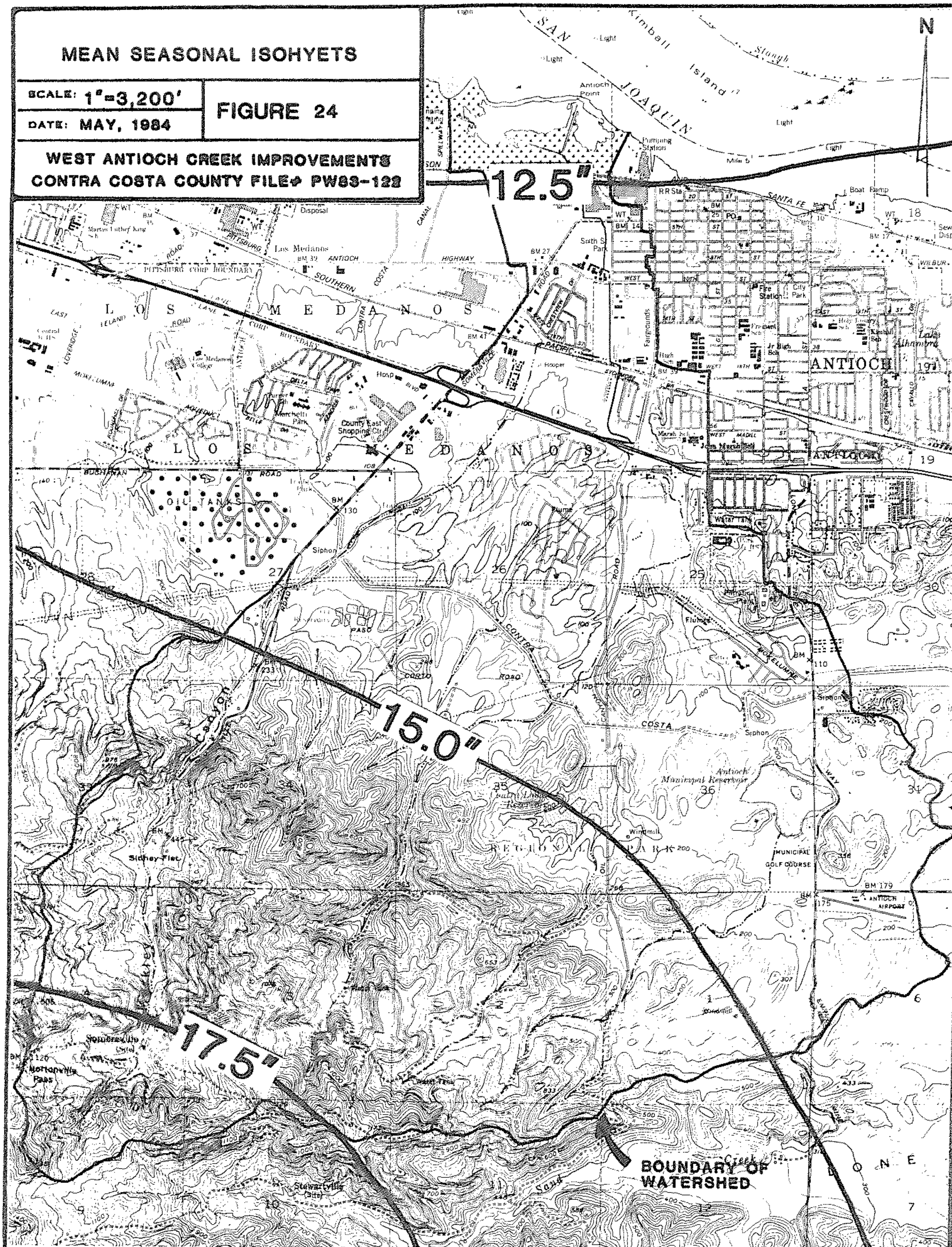
On Figure 23, the watershed of West Antioch Creek has been divided into three (3) subwatersheds: a) Markley Creek watershed, b) West Antioch Creek watershed (above confluence with Markley Creek), and c) West Antioch Creek watershed (below confluence with Markley Creek). Thus, runoff from 11.35 sq. mi. (8.1+3.25 sq. mi.) would be carried by the proposed improvements, along with surface waters intercepted from the lower portion of the watershed (additional 0.65 sq. mi.). As previously noted, the official flood hazard boundary maps suggest that approximately 108 acres of incorporated and unincorporated area is presently subject to inundation by peak discharge from the 100-year flood in the area between the AT&SF Railroad and the SP Railroad. It is the flood hazard in this lower segment of the watershed that would be ameliorated by the proposed project.

Rainfall

Seasonal Totals. The County Flood Control and Water Conservation District analyzed rainfall records compiled from 1879-1973 to generate a map of Contra Costa County showing mean seasonal rainfall. Figure 24 shows the seasonal totals (in inches) for the West Antioch Creek watershed. A systematic decrease in rainfall across the watershed from south to north is apparent. Utilizing the rainfall records, a series of curves have been generated to show the relationship between duration (of storm), frequency (recurrence interval), and depth (of rainfall).

For purposes of comparison, the rainfall total for the three (3) most recent years are presented in Table IV. These data indicate that the winters were unusually wet during the 1981-82 and 1982-83 seasons. Within the historic record there is some evidence to support the existence of climatic cycles (i.e. periods of a decade or more that are wetter than normal followed by periods of similar length that are dryer than normal. Moreover, the geologic record contains unequivocal evidence of longer-term climatic cycles. The cyclic nature of weather patterns warns against assuming that the wet winters of 1981-82 and 1982-83 are unusual events that have a low probability of occurring during the


WATERSHED MAP
SCALE: 1"=3,200'
DATE: MAY, 1984
FIGURE 23
WEST ANTIOCH CREEK IMPROVEMENTS
CONTRA COSTA COUNTY FILE# PW83-122
EXPLANATION
Subwatershed Boundary
Perennial Stream (channel of West Antioch Creek north of Highway 4)
Intermittent Stream (Markley Creek and tributaries of West Antioch Creek south of Highway 4)
BRACKISH MARSH
WEST ANTIOCH CREEK WATERSHED (BELOW CONFLUENCE WITH MARKLEY CREEK)
405 AC.
(.65 SQ. MI.)
WEST ANTIOCH CREEK WATERSHED (ABOVE CONFLUENCE WITH MARKLEY CREEK)
5205 AC.
(8.1 SQ. MI.)
MARKLEY CREEK WATERSHED
2089 AC.
(3.25 SQ. MI.)
BOUNDARY OF WATERSHED
ANTIOCH
N


MEAN SEASONAL ISOHYETS
SCALE: 1"=3,200'
DATE: MAY, 1984
FIGURE 24
WEST ANTIOCH CREEK IMPROVEMENTS
CONTRA COSTA COUNTY FILE# PW83-122
N
12.5"
15.0"
17.5"
BOUNDARY OF WATERSHED
ANTIOCH
SAN JOAQUIN
LOS MEDANOS
OIL TANKS
Sidney Flat
Antioch Municipal Reservoir
MUNICIPAL GOLF COURSE

coming decades.

It should also be recognized that a rainstorm on January 4th, 1982 dropped 4.5 inches of rain in the lower portion of the watershed. (Proportionately higher amounts of rain fell at higher elevations in the watershed.) The 4.5 inches amounts to 36% of the mean seasonal rainfall. This event caused damage amounting to several hundred thousand dollars in terms of property damage, damage to manufactured products, and lost production time. According to the duration (of storm), frequency (recurrence interval), and depth (of rainfall) curves prepared by the Flood Control District, a storm like the January 4th event has a recurrence interval of more than 100 years (i.e. one event per 100+ years). However, an even more severe rainstorm occurred in the 1960's. In other words, the rainfall records of the past 100 years are a useful guide to prediction of rainfall patterns in the next 100 years, but they are not infallible.

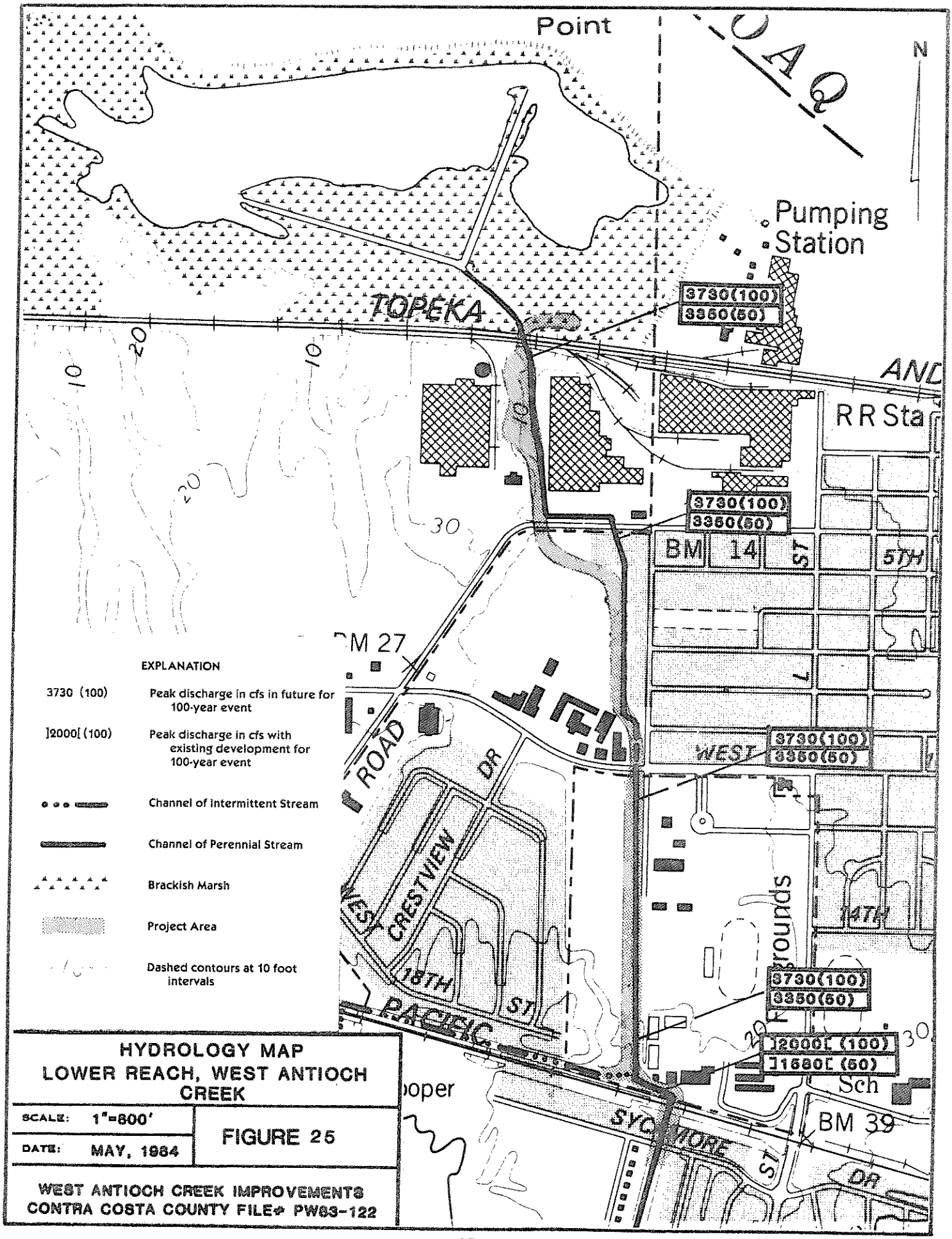
TABLE IV. COMPARISON OF SEASONAL RAINFALL TOTALS FOR THE 1980's WITH MEAN SEASONAL TOTALS

SEASON	SEASONAL TOTAL (INCHES)
July, 1980 - June, 1981	7.74 (62% of normal)
July, 1981 - June, 1982	20.73 (166% of normal)
July, 1982 - June, 1983	26.06 (209% of normal)

Runoff

There are no records of past flood events because there are no gauging stations on West Antioch Creek. Hydrologic analyses were performed by the Flood Control District to establish the expected peak discharges for the 50-year and 100-year runoff events with existing development, and with the future development that is anticipated (see Figure 19 for assumed future land use). The peak discharge figures for the 50-year and 100-year events are presented in Figure 25. The data indicate that the peak discharge from the 50-year event would be 3350 cubic feet per second (cfs) throughout the entire project area. Similarly, the peak discharge from the 100-year event would be 3730 cfs throughout the project area. Thus, the 100-year event represents a 380 cfs increase over the 50-year event (11% increase).

These peak runoff estimates were the basis for the Flood Control District's design of the planned improvements. The proposed project (and alternative) would be able to carry the 50-year and 100-year events with two to three feet and one foot of freeboard, respectively. This would effectively



HYDROLOGY MAP
LOWER REACH, WEST ANTIOCH CREEK

SCALE: 1"=800'	FIGURE 25
DATE: MAY, 1984	

WEST ANTIOCH CREEK IMPROVEMENTS
CONTRA COSTA COUNTY FILE# PW83-122

reduce the threat of flooding in the area north of the SP Railroad.

It was previously noted that 108 acres of the watershed are subject to inundation by the 100-year flood between the SP Railroad and the AT&SF Railroad. It should be recognized that the improvement within the SP Railroad right-of-way would also reduce flooding in the residential area between the railroad embankment and State Highway 4.

G. Water Quality

Groundwater

The Water Resources Division of the U.S. Geological Survey has been monitoring several wells within the region for the past 5-10 years to determine water levels and water quality. The water level in a 93-foot deep well has fluctuated between 51 feet (in 1973) to 56 feet (in 1977). All of the wells have been monitored for water quality since 1972 by measuring the amounts of dissolved chloride and the specific conductance. These are two secondary standards of water quality which refer primarily to the aesthetics and palatability of the water. The California State Department of Public Health recommends that dissolved chloride concentrations not exceed 250 milligrams per liter (mg/l), and that specific conductance not exceed 900 microhms per centimeter (μohm/cm). These are general standards, and they reflect the relative tolerance of people to these minerals based upon palatability rather than health standards. The wells sampled have a range of dissolved chlorides from 76 mg/l to 490 mg/l, and a total dissolved minerals range from 755 to 3270 μohm/cm. With the use of a conversion factor of 0.6, the conductivity of the water can be expressed as 453 to 1962 parts per million total dissolved solids (ppmtds). The palatability of the groundwater is fair-to-poor based upon these data, and the results are consistent with the Water System Master Plan Study for the City of Antioch.

The proposed project is not expected to have a measureable effect on the elevation of the watertable or the quality of groundwater. The project would contain floodflows, essentially eliminating overbank flooding. Under existing conditions, there is an opportunity for ponded floodwaters (on the floodplain) to percolate through soils and alluvium on the floor of the channel to the watertable. In the segment of the project that would consist of a lined channel, the potential for percolation would be nil. The project would not result in contamination of the groundwater.

Surface Water, Channel of West Antioch Creek

In its natural condition, the channel of West Antioch Creek carries suspended sediment. It can also be inferred to contain coliform bacteria, along with detergent, grease, oil and litter in concentrations common to streams which drain urban watersheds. These materials ultimately reach the brackish marsh and the San Joaquin River. In high concentrations such substances are toxic to fish and wildlife. In channels which drain urban watersheds that are chiefly residential and "clean" industrial uses, the concentrations of such pollutants would not be high. Supporting this conclusion, fingerlings, crayfish and egg clusters were observed in the reach of West Antioch Creek between Somersville Road and the AT&SF Railroad. Additionally, the tracks of racoons were observed along the edge of the channel, suggesting that the creek is a source of water for mammals.

Brackish Marsh

There are no definitive studies on water quality in the brackish marsh north of the AT&SF trestle. However, a study of water quality in the Carquinez Strait-Suisun Bay area provides background-level information on the overall characteristics of water in the estuary (see Table V). The data presented in Table V suggest that water quality is relatively good at present. Changes are inevitable in the estuary, given the forecast for increased population, industrial expansion, potential for decreased delta outflow, and effect of the San Luis drain. These changes do not necessarily create water quality problems. With effective controls over waste treatment, monitoring of water and effluent quality, and prevention programs to minimize industrial and harbor accidents, the estuary can continue to serve a broad spectrum of industrial and recreational uses, as well as provide a productive habitat for fish and wildlife.

With regard to the proposed project, a significant element of the project is a stilling/sedimentation basin intended to capture some of the sediment which currently is washed into the marsh. Regulating the amount of sediment released into the marsh is beneficial. High volumes of sediment are capable of overwhelming and burying vegetation, as well as choking waterways. Over the long-term, sedimentation will convert the marsh into an alluvial plain.

A study of the East Antioch Creek watershed performed by Torrey and Torrey (1981) estimated that 1.4 to 3.4 acre feet (2,000 to 6,000 cubic yards) of sediment are carried down East Antioch Creek annually. The West Antioch Creek watershed is somewhat larger, steeper, and the rainfall is greater. Consequently, the volume of sediment transported by West Antioch Creek is in the same range (or slightly

TABLE V. SUMMARY OF SELECTED WATER QUALITY PARAMETERS
CARQUINEZ STRAIT - SUISUN BAY

Parameter	Commentary
1. Temperature	
Seasonal temperature varies from 10°C to 20°C. Maximum occurs in late summer	Spring temperature rise and autumnal declines affect the reproductive cycle of anadromous fishes. Also affects algae growth, dissolved oxygen concentrations.
2. Turbidity	
The turbidity of the Strait has remained rather consistent over the period that it has been monitored (1963-present)	Secchi disc measurements average 12 inches. (The disc disappears at a depth corresponding to about 20% of surface light intensity.
3. Color	
Water color ranges from blue to brown, dependent upon the angle of observation and proximity of viewer to the water. On close inspection, the waters usually appear murky. Cloudiness of waters reflects the high concentrations of suspended silt, and in late summer may be amplified by algae.	Outfalls into the estuary can alter the visible appearance of the receiving waters, but background conditions in Carquinez Strait mask this effect.
4. Bottom Deposit	
Sediments on floor of the channel consist chiefly of clay-silt	Changes can be marked near outfalls in the estuary, particularly changes in character, abundance and diversity of benthonic animals and organic content of sediments.
5. Oils and Grease	
Oils and grease in bay waters is a result of man's activities. Major sources include waste effluents, land drainage and spills	Crankcase oils and grease spilled in creeks are carried into marsh, where they tend to coat vegetation.
6. Odors, particularly from industrial wastes, can be objectionable, but these are not currently considered a problem	
7. Dissolved Oxygen	
Dissolved oxygen concentrations have never been known to be dispersed in Carquinez Strait. Measurements show a seasonal variation from 8 mg/l± in summer to 11 mg/l± in winter	Oxygen concentrations are a general indication of the "state of health" of bay waters. No oxygen problem is known to exist in Carquinez Strait.
8. Pesticides	
Pesticides, primarily chlorinated hydrocarbons, are found in San Francisco Bay waters, on sediments and within tissues of aquatic life	Most pesticides are quite insoluble in water and are found only in minute quantities in water samples; yet these same compounds are readily dissolved and held in animal fatty tissues and become concentrated in aquatic life.
9. Coliform Bacteria	
Bacteria of the coliform group are found in the feces of warm blooded animals and in soil. Coliform in bay waters may originate from municipal waste discharges or from land drainage, particularly during wet periods. A study performed by U.C. Berkeley found coliform numbers exceeded 1,000 per 100 ml at least 50 percent of the time at most stations	The coliform concentrations at all stations were in excess of shellfish harvesting standards (1972) Coliform concentrations have been declining as new subregional sewer plants have become operational.

Source: Contra Costa County Water Quality Study by Brown and Caldwell (1972)

greater). The design of the stilling/sedimentation basin would cause sediment to fall out of suspension in the calm water. The periodic removal of these sediments from the basin would be easier, less costly (and less environmentally damaging) than performing cleanup work in the marsh area.

H. Vegetation and Wildlife

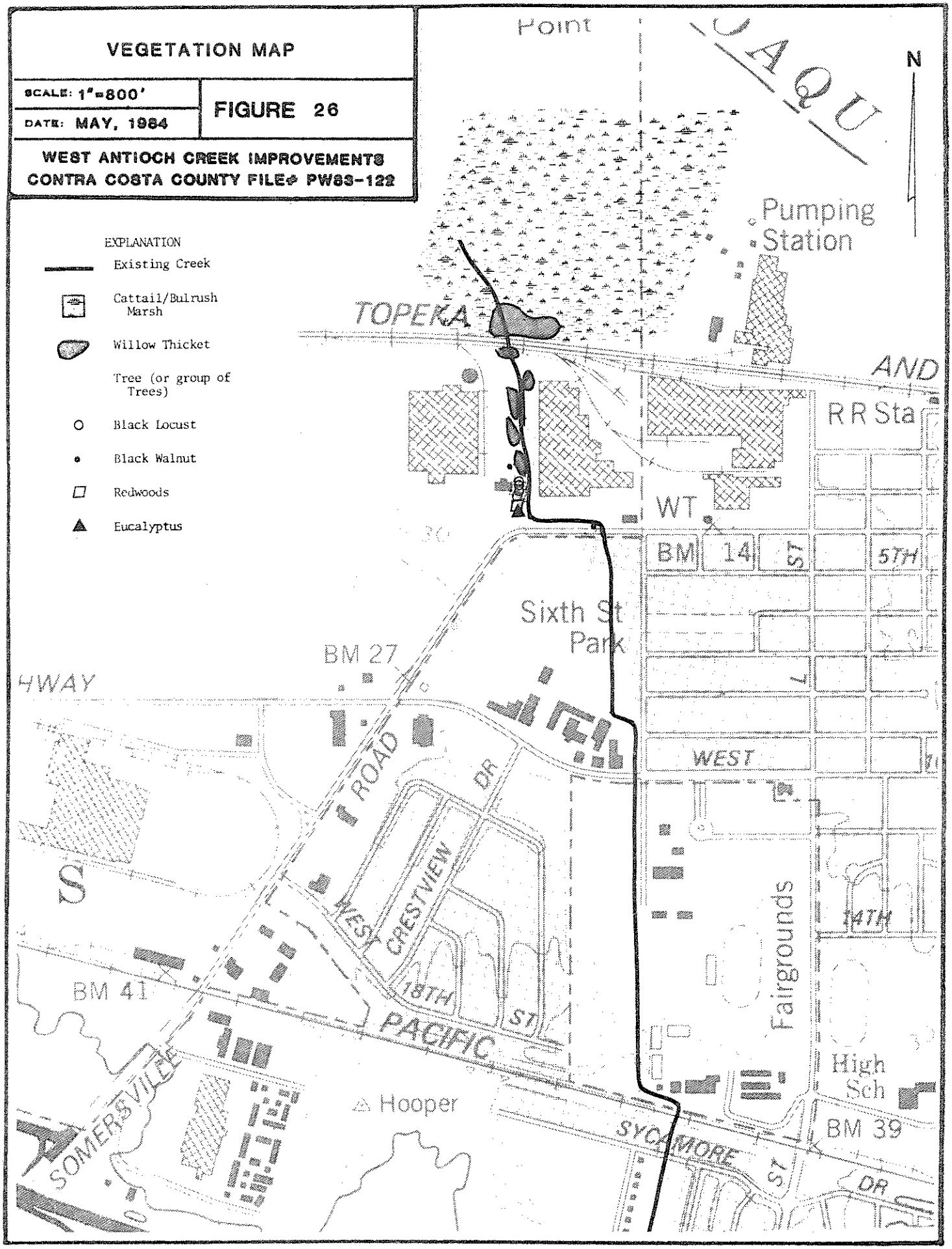
Vegetation

Vegetation along West Antioch Creek is composed of both native and non-native plant species, forming primarily three (3) "vegetation types." These types include marsh, riparian, and ruderal (i.e. uncultivated, wild) vegetation. Significant vegetation along the creek is indicated in Figure 26.

The most complex and important, in terms of the resources they provide to wildlife, of these vegetation types, occur north and immediately south of the AT&SF right-of-way. This area supports riparian vegetation, composed primarily of thickets of arroyo willow and marshland. The willow reaches heights of up to 20 feet, and is associated primarily with blackberry, creating dense impenetrable thickets. The largest thicket occurs immediately north of the railroad tracks and occupies an area of approximately 1/2 acre. In addition to providing important protective cover to wildlife in the area, the thicket also serves to slow fast moving flood water flows as they reach the marsh. This thicket is expanding rapidly to the east, into the upper elevations of the marsh, with willow saplings occurring at a frequency of one or more every five square meters. Smaller thickets occur along the creek between the railroad tracks and Somersville Road. The extent of these thickets is indicated in Figure 26.

Marsh vegetation occurs primarily north of the railroad tracks, where water from the creek slows as it moves toward the San Joaquin River. The marsh, which is subject to tidal action, is composed of both fresh and salt-water marsh species. Fresh-water flows from West Antioch Creek result in a predominance of species which prefer fresh or brackish water. These species include cattail, bulrush, sedges, and rushes. The cattail and bulrush, interspersed with large to small bodies of open water, form extensive stands which stretch from the railroad tracks northward to the San Joaquin River. Several species indicative of salt-water are interspersed throughout the marsh and include pickleweed, salt grass, gumweed, and brass buttons.

The upper stretches of the creek, south of Riverview FPD administrative offices, are fringed with primarily ruderal plant species. Repeated dredging and other activities along


VEGETATION MAP
SCALE: 1"=800'
DATE: MAY, 1984
FIGURE 26
WEST ANTIOCH CREEK IMPROVEMENTS
CONTRA COSTA COUNTY FILE# PW83-122
EXPLANATION
Existing Creek
Cattail/Bulrush Marsh
Willow Thicket
Tree (or group of Trees)
Black Locust
Black Walnut
Redwoods
Eucalyptus
Point
CAQU
N
Pumping Station
TOPERA
AND
RR Sta
WT
BM 14
5TH
Sixth St Park
BM 27
4WAY
WEST
ROAD
DR
CRESTVIEW
18TH
ST
PACIFIC
BM 41
SOMERSVILLE
Hooper
Fairgrounds
14TH
High Sch
BM 39
SYCAMORE
DR

this portion of the creek have prevented the establishment of riparion vegetation other than rushes and sedges. Species that occur in the annual grassland which fringes the upper stretches of the creek grow to the water's edge. These grassland species are primarily introduced annuals and include wild oat, wild mustard, wild radish, filaree, dock, and plantian. A number of large trees, planted as landscaping around the old high school, grow within 200 feet of the creek. These include a small grove of eucalyptus, several redwood and black locust, black walnut, and Monterey pine. Although these trees do provide nesting substrate and some food crop, they also contribute to the aesthetic quality of the historic structure.

Wildlife Habitat and Vegetation

Marsh and riparian vegetation perform significant roles in the regional ecosystem. They provide valuable wildlife habitat and enhance the fishery resources of the area. Successful establishment and growth of these vegetation types is crucial to the control of erosion and siltation along the creek and in the marsh. A number of factors contribute to the great diversity of wildlife species which utilize the habitat created by these vegetation types. These factors include the presence of a permanent water source, the abundant food crops produced by plants, the protective cover provided by dense vegetation, the creation of "edge" habitat, and their function as movement corridors. The presence of water attracts those species dependent on a water-oriented habitat such as the green heron, a number of duck species, egret, belted kingfisher, muskrat, western pond turtle, and several amphibians, as well as species which require drinking water on a regular basis. The "edge" phenomenon is created where different habitat types intergrade, providing resources of both habitat types to wildlife species which are adapted to movement between two or more habitat types. This is true for species which feed in the grassland which borders the marsh and creek areas and retreat to the willow thickets and other dense vegetation for cover. Common species exhibiting this pattern include mourning dove, scrub jay, brown towhee, gold- and white-crowned sparrows, and jackrabbit. In addition, the marsh and particularly the creek, serve as important movement corridors providing relatively secure routes where wildlife species can move from one area to another.

What little riparian vegetation exists along West Antioch Creek protects and enhances the aquatic habitat of the lower stretches of the stream. The streamside vegetation provides some shade and also acts as a source of direct and indirect insect food by dropping detritus and insects into the water. Gamefish such as steelhead trout and rainbow trout were historically found in a number of creeks in the area. These creeks supported annual runs of steelhead, and

in some cases, silver salmon. Past and present land use changes, however, resulted in changes in the diversity and occurrence of these species by altering conditions along and in the creeks. Due to industrial land use adjacent to the creek, in combination with the heavy sediment loads that are carried, it is unlikely that West Antioch Creek presently serves as a viable steelhead or trout fishery.

A number of wildlife species in the project area are dependent solely on the resources provided by the marshland. In particular, a population of long-billed marsh wren occupy the stands of cattails immediately north of the large willow thicket. The long-billed marsh wren, although highly vocal during the mating period, is extremely elusive and sensitive to intrusion. Males of the species occupy small territories and attempt to invoke females to use one of a number of nest shells the male constructs in the stands of cattails.

The male wrens may have several or no mates during a given season. Wrens which establish territories in the project vicinity are most likely part of the population of wrens which are known along the southern bank of the San Joaquin River.

Rare, Endangered and Threatened Species

Review of the overlay maps maintained by the Contra Costa County Planning Department indicates no reported citing of rare, endangered or threatened species of plants or animals in the project area.

I. Cultural Resources

Archaeology

The archaeologic sensitivity of the project area was evaluated by the Anthropological Studies Center, Cultural Resources Facility of Sonoma State University. Based on review of available published and unpublished sources, it was concluded that the area contained no recorded prehistoric sites. The letter from the Anthropological Studies Center (dated 29 February 1984) concludes that there is a low possibility of unrecorded prehistoric sites, but it states that no further archaeological study is warranted. Moreover, it is recommended that if archaeologic materials are uncovered during construction, earthwork be stopped until a qualified archaeologist has evaluated the significance of the find. Project personnel should not collect archaeological materials.

Historic Structures and Sites

No buildings or sites in the vicinity of the project area are listed in the National Register of Historic Places, or

in the California Inventory of Historic Resources. However, the Contra Costa County Inventory of Historic Resources identified the building that serves as the Riverview Fire Protection District administrative offices as a structure of historic significance and an architectural specimen (see Figure 27). This building is the former Riverview Union High School. The school district was established in June, 1903 and the school opened in 1910 with 32 pupils. The district included Antioch, Black Diamond, Somersville, Carbondale, and later the Live Oak area. The structure is a two-story brick building with quoin wall design, flat roof with parapet and decorated window detail. This proposed project would result in loss of mature trees east of the building, but the structure itself would be retained.

Other structures of historic significance, sites of historic events and architectural specimens are located in the old town center of Antioch, approximately 2,000 feet east of the project area. The nearest of these is the AT&SF Railroad Depot, which was built around 1902.

J. Visual Quality

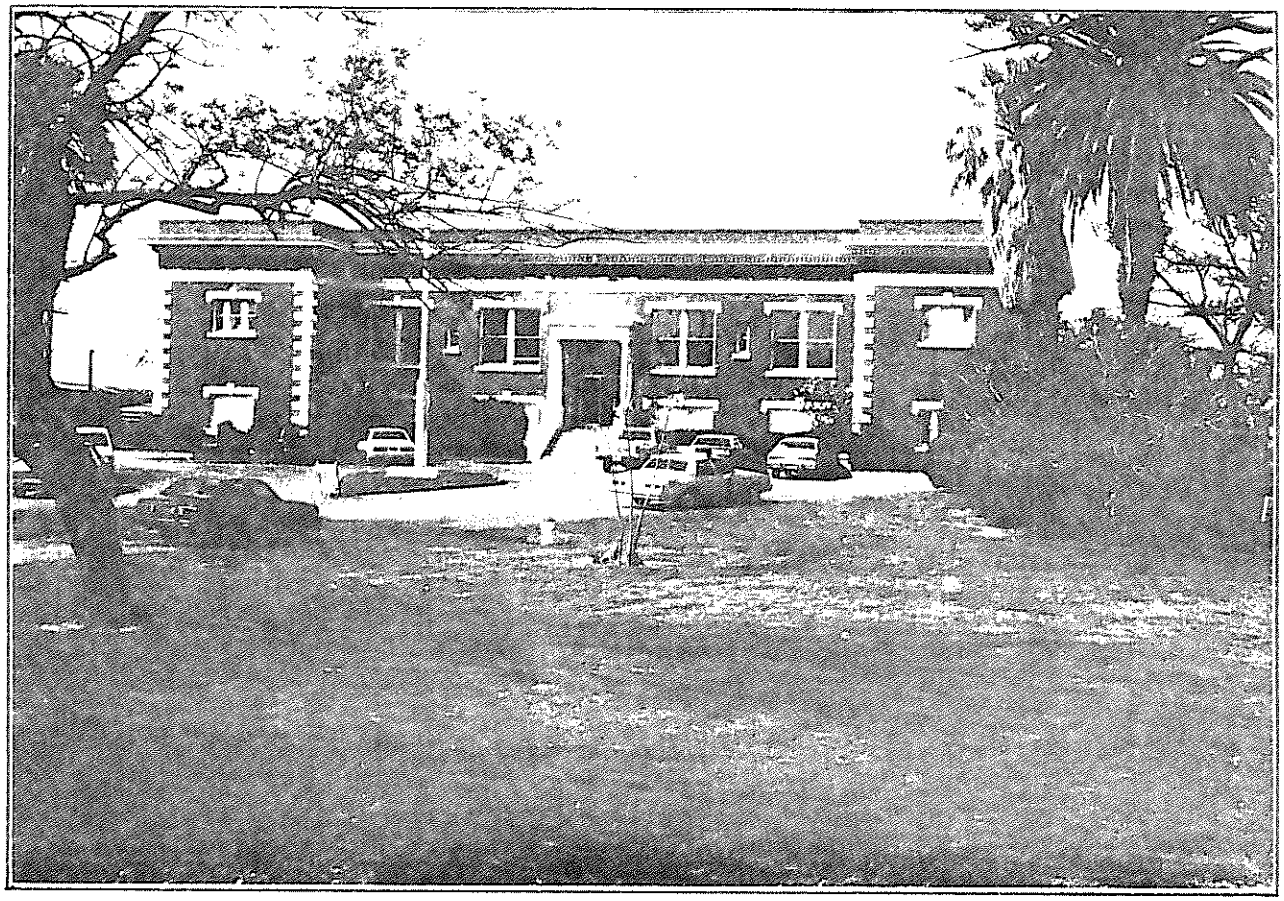
The project area is located on an alluvial plain which slopes gently to the north at 2%±. Long-range views of the project area are not available. Short-range views are presented in Figures 12 through 15. In understanding the visual significance of the project, the following points should be considered.

1. The project is not visible from a scenic route or from boat traffic on the San Joaquin River.

2. The northern portion of the project traverses an industrial area. In such areas, preservation or enhancement of views are not generally considered a high priority.

3. Somersville Road is not designated a scenic route in the County's scenic routes element. The channel is visible only momentarily from the bridge crossing, and the view is obscured by a 30-inch high concrete barrier on the edge of pavement.

4. South of Somersville Road, the channel separates the Princess Apartments and commercial properties on the west side of "O" Street from a vacant parcel zoned for light industrial development. Figure 14, View G, indicates that this reach of the existing channel is not a creek of outstanding natural beauty. A landscaped project offers an opportunity to enhance the natural beauty of the channel, and the project would provide a more substantial buffer between the



Front view, Riverview Fire Protection District Administrative Offices. This building is locally considered to be a structure of historic significance and an architectural specimen. The channel of West Antioch Creek passes approximately 100 feet east(to right) of building. (Photograph taken from the Somersville Road frontage of the property.)

RIVERVIEW F.P.D. ADMINISTRATIVE OFFICES	SCALE:	FIGURE 27
	DATE: MAY, 1984	
	CONTRA COSTA CO FILE# PW83-122	

apartments and the industrial property across the creek.

5. Traffic on 10th Street has short-range views of the segment of the channel on the Contra Costa Fairgrounds parcel. 10th Street is not a scenic route, and landscaping the channel on the fairgrounds offers an opportunity to enhance views of the channel.

K. Air Quality and Noise

Air Quality

The project area is near the boundary of the Sacramento Valley and San Francisco air basins, characterized by a semi-arid climate. Winds blowing out of the west through Carquinez Strait provide a major source of ventilation for the Sacramento and San Joaquin Valleys, especially during the summer months. Wind velocities are generally moderate with a mean windspeed of approximately 10 MPH. Temperatures in the area are mild throughout the year. Average maximum temperatures are in the high 80's in the summer. Winter highs are typically in the 50's. Average annual rainfall varies with elevation. In the project area, it is approximately 12.5 inches.

The Bay Area Air Quality Management District (BAAQMD) maintains an air quality monitoring station in Pittsburg, less than five (5) miles upwind from the project area. A four-year summary of the data collected at this station is presented in Table VI. The data show that the air is sometimes in violation of the standard for total suspended particulates (33 days in violation of the standard during the four-year period 1979-1982). The ozone level violated the standard two (2) days during the same four-year period. The particulate matter in the air is due to natural sources such as windblown dust and pollen, and manmade sources such as automobiles, field burning, vehicular traffic on unpaved roads, and earthmoving activities.

With regard to other pollutants, the air quality in the Pittsburg-Antioch area appears to be good. Moreover, a research report issued by the BAAQMD projects a general trend toward improving air quality, even with the development that is anticipated in the San Francisco Bay Region. This projection is attributable in part to the fact that the vehicles in service in the future years will show a consistent reduction in the grams of pollutants that are released into the air per mile driven. (For further information see BAAQMD report entitled, "Vehicle Emission Factors Update", dated July 15, 1981.)

TABLE VI. AIR POLLUTION SUMMARY
PITTSBURG MONITORING STATION

Pollutant	Standard	1979	1980	1981	1982
Ozone (Oz)					
highest hourly avg/pphm	12/a/	14	13	11	10
days standard exceeded	----	1	1	0	0
Carton Monoxide (CO)					
8 hour average/ppm	9/a/	5.6	5.6	4.0	4.9
days standard exceeded	----	0	0	0	0
Nitrogen Dioxide (NO_2)					
Highest hourly avg/pphm	25/b/	8	9	7	9
days standard exceeded	----	0	0	0	0
Sulfur dioxide (SO_2)					
highest 24-hour avg/ppm	0.05/b/	.011	.027	.010	.007
days standard exceeded	----	0	0	0	0
Total Suspended Particulate(TSP)					
annual geometric mean /$\mu g/m^3$	100/b/	60	66	61	53
days standard exceeded	-----	9	14	4	6

/a/ Federal Standard
/b/ State Standard

Source: BAAQMD

Noise

The primary sources of noise in the project area are highways (Somersville Road and 10th Street) and the railroads (SP and AT&SF). According to the Noise Elements of Contra Costa County and the City of Antioch, Somersville Road and 10th Street are not significant sources of transportation noise. The project itself, would be a source of noise only during the construction period.

Receptor locations which could experience noise impacts as a result of construction include those adjacent to the project and also those which would be on access routes used by diesel trucks. The primary local truck routes would be Somersville Road and the segment of 10th Street between Somersville Road and "O" Street. The potential receptors are commercial and industrial properties, along with the Princess Apartments. The extent to which these receptor areas may be subject to construction noise impacts is evaluated in Section III of the EIR.

L. Energy

The proposed project will involve direct energy inputs in fuel use for construction, for long-term maintenance, and for materials, equipment, and personnel transportation to and from the site. It will also involve indirect energy inputs in the production of fuel and materials, and their transportation to supplier distribution points.

Table VII shows summaries of estimated, direct energy inputs for both the concrete-lined and earth-channel project alternatives; and some sample residential energy-input estimates for comparison with project estimates. (A detailed energy use study is contained in Appendix E.) Estimated energy use for both alternatives is similar, and compared with typical 20-year energy inputs for moderate-size residential developments, is relatively minor. Unlike commercial or residential developments, the project would essentially be a one-time energy user, with about 90% of 20-year energy input devoted to initial construction (with either alternative) and the remainder devoted to long-term maintenance.

Though the earth-channel alternative would involve somewhat greater energy use than the concrete-lined channel (primarily because of the greater amount of earthwork required), neither alternative would involve significant energy use. However, in terms of cumulative, long-term energy use, the concrete-channel alternative would be most desirable because the earth channel would require 18% more initial energy input and somewhat greater long-term maintenance input.

TABLE VII. ESTIMATED ENERGY BUDGET

SUMMARY OF ESTIMATED, DIRECT ENERGY INPUTS FOR ALTERNATIVE IMPROVEMENTS OF WEST ANTIOCH CREEK, DRAINAGE AREA 55 (PW 83-122)*

	Concrete-Lined Channel		Earth Channel	
	BTU x 100,000 (therms)**	% of Total	BTU x 100,000 (therms)	% of Total
INITIAL ENERGY INPUTS				
Transportation of Excavated Materials	6,369	10.2	10,726	14.5
Transportation of Construction Materials	14,768	24.0	7,803	10.8
Construction	36,428	59.2	48,512	66.9
ENERGY INPUTS FOR LONG-TERM MAINTENANCS (20 Years)	3,926	6.4	5,493	7.5
TOTAL 20-YEAR DIRECT ENERGY INPUTS ESTIMATE	61,491	100.0	72,534	100.0
ESTIMATED ENERGY INPUT IN BARRELS OF OIL***	1,060		1,250	

* Not including direct inputs for manufacture of materials or fuel, or transportation of materials or fuel to supplier distribution points.

** One therm = 100,000 BTU. A BTU (British Thermal Unit) is the amount of heat needed to raise the temperature of one pound of water by one degree F.

*** One barrel of oil = 5,800,000 BTU.

SAMPLE, ESTIMATED ENERGY INPUTS PREVIOUSLY CALCULATED FOR PROPOSED RESIDENTIAL DEVELOPMENTS - FOR COMPARISON WITH ESTIMATED ENERGY INPUT FOR THE PROPOSED PROJECT*

	Initial Construction (therms)	Long-Term Inputs (therms)	20-Year Total (therms)	20-Year Total (barrels)
19 detached units, PUD, hillside development, Shepherd Canyon, Oakland	250,384	1,433,553	1,683,937	29,033
10 units, hillside PUD, Skyline Blvd., Oakland	145,028	758,300	903,408	15,576
200-unit PUD, attached + detached, with recreation facilities and sewer treatment plant, Port Costa/Crockett area	3,019,575	27,597,184	30,616,759	527,875

* These estimates include indirect energy inputs for production of materials and fuel. However, as can be seen by comparing them with the estimated inputs for the project, even if the project estimates were doubled to account for indirect inputs, the estimated energy use for the project would be substantially less than the two smallest residential developments. For residential developments, energy-use calculations typically indicate that long-term inputs (household gas and electricity, facilities maintenance, and travel to and from the site) will amount to 80-90% of 20-year energy use, and initial construction will amount to 10-20%.

III. ENVIRONMENTAL IMPACT ANALYSIS

A. Land Use

1. Future Development in Watershed

Impact. The proposed improvements would be adequate to carry runoff if future development in the watershed is limited to the City of Antioch's sphere of influence, including the properties that are presently being considered by LAFCO for annexation. Significant expansion of the City into the hills south of the existing sphere of influence would result in increased runoff. For example, conversion of agricultural lands to high density residential development would approximately double the amount of runoff, along with increasing the speed of runoff. The proposed project has been designed with 2 to 3 feet of freeboard. That freeboard is necessary as a safety factor to contain waves on the water surface and still permit the channel to carry runoff from the 50-year and 100-year events.

It should be recognized that the assumed future land uses in the watershed (Figure 28) considered the development potential of the 600± acre area southwest of the Antioch Airport to be nil, even though the area is in the City's sphere of influence. Should the area develop, the safety factor that was built into the design of the project would be eroded.

Mitigation Measures. Agricultural preserve contracts should be encouraged in the area south of the existing sphere of influence to mitigate against possible encroachment of residential development into this area. The 600± acre area of the City's sphere of influence (located southwest of the Antioch Airport) should be accorded a low development potential.

2. Fairground Property

Impact. The proposed project would require a drainage right-of-way across the County Fairgrounds property that would be approximately 160 feet wide; the existing channel is approximately 50 feet wide. The short-range effect of the project would be the loss of approximately 5 acres of parking. (At present, fairgrounds parking is only marginally adequate). Over the long-term the loss of parking, along with the increased value of the property because of the reduction in flood hazards, may hasten the day when a fairground use of the parcel will be considered obsolete.

Mitigation Measure. To at least partially offset the loss of 5 acres of parking, it is recommended that a parking and circulation study of the fairgrounds be undertaken. The purpose of the study would be to maximize utilization of the remaining areas for parking and to provide for efficient circulation of traffic.

Although it is conjectural, the surrounding land uses suggest that the ultimate use of the fairgrounds property may be as a single-family residential subdivision, with the possibility of multiple-family residential or service commercial along the 10th Street frontage. The standard single-family lot in the City's R-1 zoning district is 60 feet wide by 100 feet deep. If wasted space is to be avoided, the precise location of the channel should take into account possible future land uses and subdivision design. Figure 28 illustrates one possible layout of a subdivision in the western portion of the fairgrounds. This layout assumes that the west boundary of the channel is 256 feet from the west boundary of the fairgrounds. The design accommodates a standard R-1 subdivision without the need for variances.

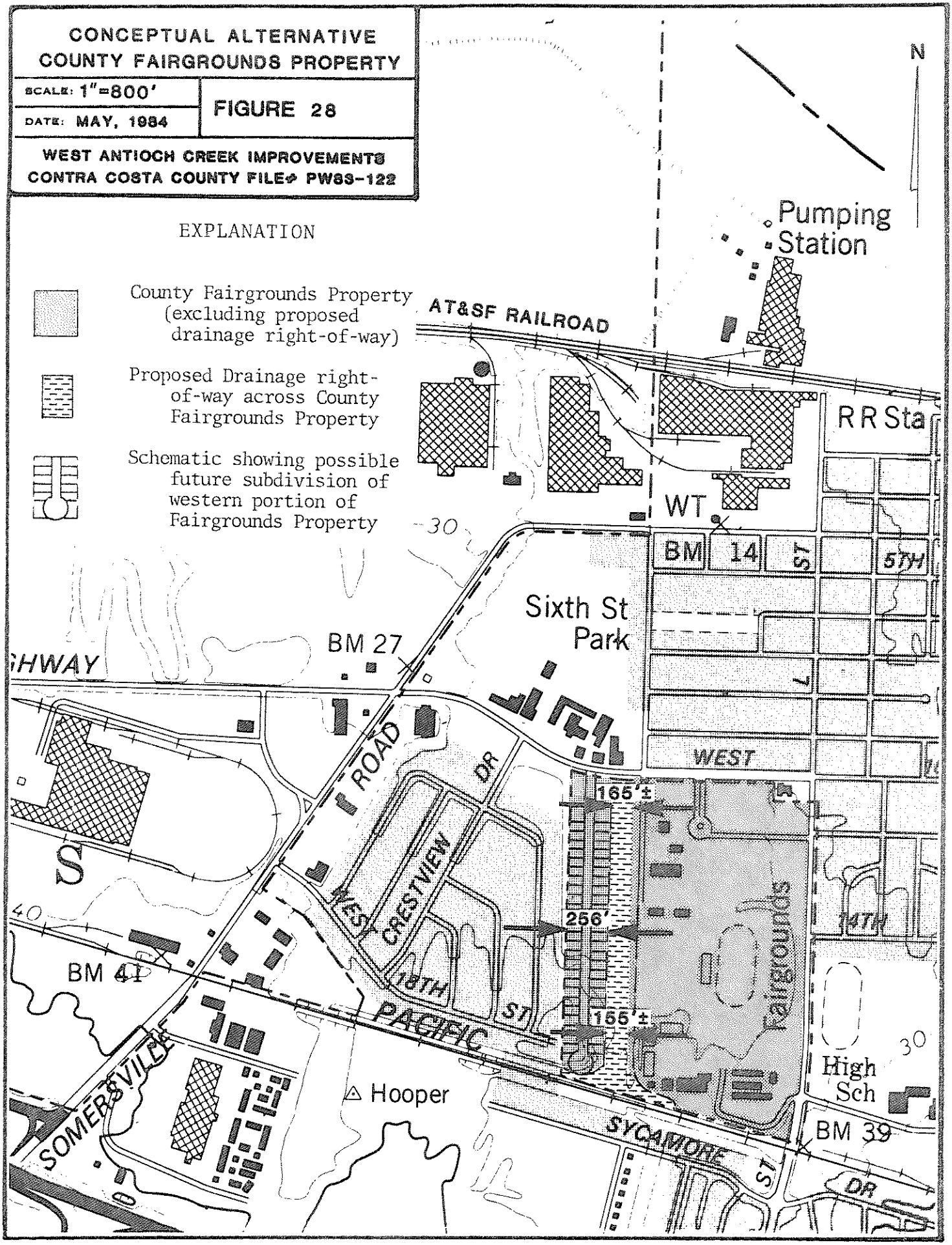
The layout shown in Figure 28 does not give consideration to the existing fairgrounds uses. The channel alignment proposed by CCCFCWCD was selected because it results in a minimum of disruption to existing land uses. The proposed east boundary of the channel right-of-way would coincide with the west edge of pavement along the fairgrounds access road (i.e. "O" Street extension). The west boundary of the channel right-of-way would be approximately 350 to 360 feet from the west boundary of the fairgrounds property. Shifting the proposed location of the channel significantly to the west would affect the existing Little League ballfield, shifting the channel to the east would necessitate relocating or destroying existing buildings that are used by exhibitors during the week of the Contra Costa County Fair. Any relocation of the channel could have an effect on hydraulics. Consequently, the design of the project would need to be reevaluated by the CCCFCWCD staff. It is possible, perhaps even likely, that aspects of the design would have to be modified.

B. Legal, Policy and Institutional Constraints

1. City of Antioch: Wildlife Habitat Values

Impact. The proposed project, if it did not provide measures to protect wildlife habitat values, could be considered to be in conflict with the goals and objectives of the Environmental Resource Management Element of the City's General Plan.

Mitigation Measure. The project design includes measures intended to protect and enhance wildlife values in the adjacent marsh area. Specifically, a sedimentation/stilling basin is proposed to trap sediment before it can reach the marsh. At the outfall of the project into the brackish marsh, an outfall pond is proposed. The purpose of the pond is to prevent erosion of the marsh by concentrated runoff. The pond would disperse runoff during episodes of heavy discharge.


CONCEPTUAL ALTERNATIVE
COUNTY FAIRGROUNDS PROPERTY
SCALE: 1"=800'
DATE: MAY, 1984
FIGURE 28
WEST ANTIOCH CREEK IMPROVEMENTS
CONTRA COSTA COUNTY FILE # PW83-122
EXPLANATION
County Fairgrounds Property (excluding proposed drainage right-of-way)
Proposed Drainage right-of-way across County Fairgrounds Property
Schematic showing possible future subdivision of western portion of Fairgrounds Property
N
Pumping Station
AT&SF RAILROAD
RR Sta
WT
BM 14
5TH
Sixth St Park
BM 27
HWAY
ROAD
DR
CRESTVIEW
WEST
165'±
256'
Fairgrounds
14TH
18TH
ST
BM 41
PACIFIC
SOMERSVILLE
Hooper
High Sch
SYCAMORE
BM 39
30
40

Additional mitigation measures are presented in Section IIIF, p. 68.

2. City of Antioch: Reevaluation of Flood Hazard Maps

Impact. The present flood hazard maps of the West Antioch Creek watershed indicate that 108 acres are subject to inundation by the 100-year flood between the SP and AT&SF Railroads. After construction of the planned improvements, owners of properties in this area would be required to purchase flood insurance, unless the official maps are revised. If the maps are not revised, they could adversely effect property values in the area.

Mitigation Measure. The 100-year flood hazard zone should be reevaluated upon completion of the flood control improvements in order to reduce the area where flood hazard insurance is required.

3. Contra Costa County Mosquito Abatement District

Impact. Altering the marsh area, construction of the outlet basin and stilling/sedimentation basin, along with the earth channel, may result in problems with increased mosquito populations.

Mitigation Measure. The findings of the Planning Commission should direct the CCCFCWCD to work cooperatively with the Mosquito Abatement District for mosquito control, as necessary.

4. Corps of Engineers

Impact. The Corps of Engineers has identified the effects of construction on water quality as a potential impact. The concern is chiefly regarding earthwork that would take place below the elevation of mean high tide and its effect on benthonic organisms and aquatic plants in the marsh.

Over the most recent 19-year period, the mean height of the highest daily tide was 3.1 feet. According to the improvement plans, the floor of the channel would be below 3.1 feet north of station 23+20. This station is located south of the Somersville Road culvert (see Appendix B, Exhibit C, for the location of this station).

Mitigation Measure. There are two (2) broad categories of measures which minimize disturbance to the marsh area adjacent to the project: a) design standards, and b) construction schedules and practices.

a. Design Standards. With regard to the project, measures have been incorporated into the design that are intended to protect benthonic organisms

and vegetation from being overwhelmed by sediment. Specifically, a sedimentation/stilling basin is planned upstream from the AT&SF Railroad. This facility will trap the coarsest material being carried by the channel, along with some silt and clay.

An outlet pond is proposed immediately north of the AT&SF Railroad, at the outfall of the project into the marsh.

The outlet pond will act as a broad-crested weir, dispersing runoff to the marsh at a relatively low, non-erosive velocity (up to approximately 4 feet/second). A channel from the outlet pond will direct low flows to an existing drainage way in the marsh.

The Vegetation and Wildlife Section (IIIF) contains a recommendation that the design of the project include provision for a permanent maintenance access to the outlet pond as a means of controlling disturbance to the marsh during routine maintenance. It is pertinent to note that a bench shown at elevation +5 feet south of the outlet pond, adjacent to the AT&SF Railroad (see Figure 8, Section A) if to be 24 feet wide. The construction of this bench is discussed in Section IIID, pp. 66-67.

b. Construction Schedules and Practices. Specific, detailed plans are needed to control the release of sediment into the marsh during construction and during the winter rainy season which would follow. The measures should include, but not necessarily be limited to the following:

Limiting the construction season to the summer period when the runoff would be low (May 1st to September 15th). Earthwork performed after September 15th should be limited to erosion control measures.

All erodable slopes should be hydromulched, or otherwise stabilized by October 1st.

Temporary cofferdams, silt fences and rip-rap should be used to control West Antioch Creek runoff and intrusion of the San Joaquin River water during the construction period.

4. California Department of Fish and Game

Impacts. The concerns and recommendations of the California Department of Fish and Game are addressed in the Vegetation and Wildlife impacts and mitigation measures (Section IIIF).

The comments of the Department of Fish and Game were incorporated into the Environmentally Superior Alternative, Section VIB, p. 75.

Mitigation Measures. The Department of Fish and Game has permit-granting authority pursuant to Fish and Game Code 1601-03. Conditions would be imposed by Fish and Game to minimize damage to the wildlife habitat in the project area, as well as the adjacent marsh. The proposed Earth Channel Alternative, along with a comprehensive plan for vegetative plantings, would mitigate most, if not all, of the potential impacts identified by Fish and Game.

C. Traffic and Circulation

1. Detours

Impacts. New culverts are required under 10th Street, and the channel crossing of Somersville Road is to be relocated. During construction the traffic on these streets would be rerouted.

Mitigation Measure. The nearest alternate route for Somersville Road traffic is 10th Street and vice versa. Consequently, it is recommended that drainage improvements within the right-of-way of one of these road crossings be completed and the road reopened prior to commencing construction of the other crossing.

2. Louisiana-Pacific

Impact. Construction of the stilling/sedimentation basin will require elimination of the private road linking Louisiana-Pacific with the Glass Container Corporation. Reportedly this road is an important link for the LP's operations. Without it, the only alternative route between the two industries is Somersville Road. This would result in slow-moving trucks making turning movements on a segment of Somersville Road that contains a sharp turn and a culverted creek crossing.

Mitigation Measure. The stilling/sedimentation basin is small. Any decrease in the size of the basin could impair its function. Alternatives that should be considered include: a) construction of a bridge across the concrete channel immediately upstream from the outlet into the stilling/sedimentation basin, or b) construction of a road adjacent to and immediately south of the AT&SF right-of-way, without reducing the volume or effectiveness of the stilling/sedimentation basin, c) if the plant operations of LP Corporation and the Glass Container Corporation were modified, it is conceivable that the need for a road connection could be eliminated.

D. Geology, Soils and Earthwork

1. Embankments

Impact. The embankments for the proposed earth channel and stilling/sedimentation basin require use of earth materials that are resistant to piping (i.e. underground or subsurface erosion), and that have favorable slope stability/erodability characteristics. The characteristics of the soils present south of Somersville Road do not appear to present any severe hazards or constraints. However, available information suggests that estuarine deposits, end-dumped fill, and other exotics that occur in the stilling/sedimentation basin and outlet pond area are marginal for use as embankments and engineered fill.

The bench on the south side of the outlet pond would, by design, be overtopped during episodes of heavy runoff, particularly during high tidal stages. If the bench is to serve as a permanent maintenance access to the outlet pond, it should be able to withstand erosive forces.

Mitigation Measure. The construction of the project would be in accordance with accepted standards. These standards include the following: a) CalTrans, State Standard Specification, Section 19 (Earthwork); b) Standard Specifications for Public Works Construction (1981 Edition); and c) Special Provisions for Construction of this project, to be developed prior to requesting bids on construction.

Because much of the material north of Somersville Road may be unsuitable for use either in embankments or engineered fills, it is recommended that a soil engineer be retained. Based on subsurface exploration and laboratory testing, the soil engineer shall determine the suitability of the excavated material, and if special processing during construction is required, the scope of the report should include recommendations to govern this phase of construction.

The soils report should provide specific recommendations pertaining to the construction of the bench on the south side of the outlet pond. These should include measures for erosion control and measures to ensure that the surface of the bench is firm and suitable for future use by maintenance equipment.

2. Engineered Fill

Impact. The proposed project will generate more fill than can be utilized within the drainage right-of-way. Fill utilized in the construction of berms within the drainage right-of-way would be placed in accordance with Public

Works standards. The standards guiding emplacement of fills outside of the drainage right-of-way are less clear.

If loose fill is end-dumped on offsite properties, it would have an adverse effect on future improvement of such properties, and it could create an erosion hazard. According to the CCCFCWCD, earthwork outside of the channel right-of-way would be subject to the grading regulations of the local jurisdiction.

Mitigation Measure. All fills should be designed and compacted in accordance with their planned use. If fill material is to be placed outside the channel right-of-way, grading permits should be secured from the local jurisdiction. The material should be emplaced under the direct supervision of a soil engineer, in accordance with the recommendations of the soil engineer's report and the grading regulations of the jurisdiction (Grading Ordinance, or Chapter 70, UBC).

E. Hydraulics

1. Scour and Erosion

Impact. In segments of the project where there is an abrupt change in the alignment of the channel, scour of the "outside" bank is a potential hazard.

Mitigation Measure. The project design includes a concrete lining where hydraulic analysis indicates that velocities would be high enough to produce scouring of an earth channel. In those bends where a concrete lining would not be required, the use of erosion control plantings is recommended. Hydroseeding with annual grasses would not be considered adequate for erosion control in such areas. Deeper rooted vegetation should be considered (brush and trees), with preference given to native riparian species.

F. Vegetation and Wildlife

1. Short-Term Effects

Impact. Construction of the planned improvements would have both short- and long-term consequences on the vegetation along West Antioch Creek, and on the wildlife species which reside in or frequent the area. In the short-term, all existing vegetation and the wildlife habitat it provides, would be eliminated by grading activities within the project area. This would include the willow thickets along the channel, and a portion of the long-billed marsh wren nesting habitat. Construction activities in the vicinity of the proposed outlet pond during the mating and nesting season could be highly disruptive to birds with established territories in this area.

Mitigation Measure. The nesting period of the long-billed marsh wren extends from late February to late August. To minimize disruption of their nesting activities, construction north of the AT&SF trestle should be delayed as late in the season as feasible, preferably after mid-August.

Providing intermittent plantings of native riparian species would reduce the period of time needed to reestablish vegetation along the creek.

2. Long-Term Effects

Impact. The long-term consequences of project implementation would be dependent primarily on two factors: 1) the frequency and extent of maintenance activities along the creek and in the proposed stilling/sedimentation basin and outlet pond; 2) the type and extent of landscaping which would be provided in areas affected by the project.

The periodic maintenance dredging of the channel and the stilling/sedimentation basin will limit the establishment of marsh and riparian vegetation. It is anticipated that dredging of the stilling/sedimentation basin would be needed approximately once every five years and the outlet pond once every 10 to 15 years (Wright, personal communication). The less frequent the disturbance to these areas, the greater their resource value.

As proposed, the only landscaping depicted along the entire creek is a small grove of willow to be planted on the north side of the outlet pond. Although riparian vegetation could eventually reestablish itself through natural processes, this would take many years.

It should be recognized that the project description does not make provision for landscaping the channel on the fairgrounds property, or in the vicinity of the Princess Apartments.

Mitigation Measures. The design of the outlet pond should make provision for maintenance access. Ideally, all maintenance work would be performed from the bench that is proposed along the south side of the outlet pond, and this bench should be designed and constructed to support maintenance equipment (i.e. cranes, dump trucks, etc.). The Flood Control District has indicated that maintenance access would not be needed along the north side of the outlet pond. This is significant because it limits the size of the area that would be affected by routine maintenance.

To minimize disturbance to wildlife, especially the marsh wren, maintenance of the outlet pond should be limited to the period from late August to the end of September. During such maintenance, full consideration should be given

to the wildlife value of trees in the project. Only trees that impair the proper functioning of drainage facilities should be removed.

A detailed landscaping plan should be prepared which utilizes native riparian and marsh species. Cattail and bulrush should be replanted in disturbed areas on the outward edge of the outlet pond. Willow should be planted around the northern edge of the outlet pond, particularly at the low flow drainage area, to control floodwater velocities into the marsh. (The large willow thicket north of the railroad presently serves to reduce high water velocities as flows reach the marsh.) Rip-rap may be necessary in this area to provide short-term protection against erosion until the newly planted thicket is well established.

Willow, cottonwood, black walnut, alder and Valley Oak should be planted intermittently along the length of the project to mitigate the loss of riparian vegetation and to enhance the existing condition of the creek. Providing intermittent plantings of native riparian vegetation along the creek would alleviate the short-term impacts by reducing the length of time to reestablish it.

It is recommended that the landscape plan be prepared by a firm experienced in the restoration of vegetation along drainage channels. The plan should have early input from engineers of the Flood Control District so that plantings and slope stabilization efforts do not conflict with future maintenance requirements or hydraulic capacity.

G. Cultural Resources

1. Archaeology

Impact. Although there are no known prehistoric sites within the project area, the possibility exists for archaeologic materials to be uncovered during construction.

Mitigation. If archaeologic materials are uncovered during construction, it is recommended that earthwork be halted within 100 feet of the find until a qualified archaeologist has had an opportunity to examine the locality and advise the Flood Control District of its significance. The archaeologist should provide recommendations to protect the site from damage, if they are deemed necessary.

H. Visual Quality

1. Trees on the Riverview FPD Property

Impact. The project design along the creek frontage of the Riverview FPD administrative offices consists of a 7-foot high concrete wall below a 15-foot high embankment fill.

The result is a full vertical section of 22 feet (elevation +2 feet to elevation +24 feet). As Figure 8, Section C indicates, the top-of-bank would be 40 feet west of the existing top-of-bank. The construction that is planned for this area would result in the loss of most, if not all, of the mature trees located along the east side of this historic structure (see Figure 26 for location of existing trees). The primary importance of these trees is as a screen that separates the former Riverview Union High School building from the industrial area to the east. The trees also provide nesting sites for birds, food for wildlife and shade.

As many trees as practical should be preserved with use of crib walls or retaining walls (as recommended by a landscape architect who should also develop a plan for the reestablishment of the lost landscape screen along the the Riverview FPD property.

2. County Fairgrounds

Impact. The fairgrounds is used for a variety of public purposes, including Little League baseball. There are unobstructed views of the fairground's segment of the channel from 10th Street. Therefore, views of this portion of the channel are more important than other segments of the project.

Figure 9, Section F indicates that the earth channel would have a 16-foot wide maintenance road at the top of bank on the west side of the channel. Maintenance on the east side would be performed from the existing roadway. Typically, a chain link fence is constructed along the edge of the drainage easement of rectangular concrete channels but not trapezoidal earth channels. The fences discourage access by the public. No trees or landscaping are indicated on the plans or section.

Mitigation Measure. The restoration and enhancement of the creek passing through the fairgrounds could offset impacts on riparian and marsh habitat at the mouth. This location offers an ideal opportunity to enhance the creek and the Antioch community. A grass covered swale with shallow, tree-studded slopes , a low flow channel and a path would provide recreational opportunities and serve as a visual amenity. Therefore, it is recommended that the landscape architect for the project develop a plan for landscaping the reach of the channel on the fairgrounds property.

I. Air Quality

1. Particulates

Impact. The only air quality effects of the proposed improvements are short-term construction impacts. Earth-moving equipment will be required to construct the channel

stilling/sedimentation basin and outlet pond. This work would be performed during the summer season which is characterized by west winds of moderate strength. The particulates (dust) picked up by the wind would increase the total suspended particular concentrations downwind.

Mitigation Measure. It is recommended that water mixed with lignin sulfonate be sprayed as often as necessary to control dust. Lignin sulfonate is an organic dust palliative approved by CalTrans for use in dust control operations.

J. Noise

Impact. The project would only be a source of noise during the construction period. Normal working hours would be 7:00a.m. till 5:00p.m. Monday through Friday, with the possibility of some work on Saturday. Loaders, bulldozers and diesel trucks would be the primary equipment used, along with concrete trucks and cranes. Individual sources of noise include the cooling fan, exhaust/muffler, and wheel noise.

For machines of the size expected to be used for the project (with 200 to 350 HP diesel engines) maximum noise levels of 85 to 92 dBA at 50 feet would be typical.

The noise impact at receptors in the project area may be characterized as follows. The industrial and commercial properties are not sensitive to noise. In the fairgrounds area, the nearest residential uses would be protected by distance (noise from a point source decreases by 6 dBA for each doubling of the distance, due to the spreading of the sound energy).

The only sensitive receptor that is sufficiently near the project to be impacted is the Princess Apartments, located in the northwest quadrant of 10th Street and "O" Street. These units are approximately 50 feet from the project. They are two-story apartments, so they would tend to serve as a noise screen for properties further east.

Mitigation Measures. Earthwork should be prohibited on weekends on the segment of the project that is south of Somersville Road. Work should not start before 8:00a.m. on the segment of the project south of Somersville Road.

A reasonable target for construction equipment noise is a maximum of 85 dBA at 50 feet. This noise level can be achieved by new equipment, or older equipment with quieting modifications.

IV. UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts are defined as those which cannot be totally eliminated by available mitigation measures. The key issues in identifying unavoidable adverse impacts is the application of proposed mitigation measures. The enumeration of these impacts below assumes that the mitigation measures recommended in each of the DEIR sections can be effected.

1. Intrusion of manmade drainage facilities that require maintenance into the marsh area. Disruption of nesting birds during construction, and again during future maintenance.

2. Loss of mature trees on the Riverview FPD property, along with loss of willows in the vicinity of the AT&SF Railroad.

3. Loss of developable land due to construction of an earth channel with maintenance roads.

4. Loss of parking spaces on the County Fairgrounds property.

5. Noise intrusion during construction, especially with respect to the Princess Apartments.

6. Construction-related problems, including dust, erosion, siltation, and construction traffic.

7. Energy consumption by construction vehicles.

8. Continued drowning hazard to trespassers, especially along the rectangular concrete segments of the channel, along with the stilling/sedimentation basin and outlet pond.

V. GROWTH INDUCING IMPACTS

The Environmental Resource Management Element (ERM) of the Antioch General Plan has as one of its objectives the preservation and protection of those areas which are susceptible to flooding. The proposed project would essentially eliminate flooding along the reach of West Antioch Creek that is north of the Southern Pacific Railroad. This would stimulate development of vacant properties in the protected area. However, it should be noted that the General Plan and Zoning indicate that these properties are slated for development (chiefly commercial and industrial).

It should also be recognized that the project will eliminate, or ameliorate, a possible constraint to development in the upper portion of the watershed. (The present flooding condition, if not corrected, could ultimately be recognized as a limiting factor on development.) When the project is completed, there could be increased pressure for annexation and development of properties in the hills immediately south of the City's current sphere of influence.

VI. ALTERNATIVES

Two (2) alternatives are presented in this section, along with the "no project" alternative. Both of the project alternatives provide a solution to the flooding problem in the lower reaches of West Antioch Creek. The principal advantages and disadvantages of each alternative are discussed.

A. No Project Alternative

The "no project" alternative would retain the channel in its existing condition. The channel has some value as habitat for wildlife, and it can carry runoff, with overbank flooding occurring after moderately intense storms when the ground is saturated, and after severe storms. However, the risk of significant flooding is expected to worsen in the future due to urbanization within the watershed. Assuming no improvements to the creek, the result could be flooding on an annual basis. The resultant damage would affect chiefly commercial and industrial properties, along with residences that front along "O" Street. The flooding would adversely affect property values, and it would prevent or hamper development of vacant industrial land in the flood area. Consequently, the "no project" alternative is not considered feasible, even if a moratorium were placed on "infilling" projects in the watershed.

B. Environmentally Superior Alternative

The California Department of Fish and Game has indicated that an earth channel with 3:1 (horizontal to vertical) banks and a heavy landscaping program would enhance the scenic and habitat value of the channel and compensate for damage to the marsh.

One advantage of this alternative is that the channel would appear as a grassy, landscaped swale that would be a visually pleasing, park-like area. Moreover, 3:1 embankments would be much less susceptible to erosion and sloughing than the 2:1 embankments that are proposed in the earth channel alternative.

The disadvantage of this alternative is that the channel traverses an area which is chiefly industrial and commercial, where views of the channel are less visible to the community. A channel with 3:1 banks would require a drainage easement approximately 20 feet wider than the proposed project. Thus, it would cost more to construct (more land to acquire, more earth to move) with no increase in flood protection. Additionally, it would probably necessitate destruction of the historic Riverview Union High School building.

C. Rectangular Concrete Channel Alternative

The Engineer's Report contains the design for a rectangular, concrete-lined channel that provides the same degree of flood protection as the proposed project (see Appendix B, Exhibit A). The principal advantage of this alternative is that a) less land is required because its walls are vertical, and b) maintenance is accomplished from the floor, eliminating the need for maintenance roads at the top of bank. Thus, it provides an opportunity to pass runoff efficiently through an area that is chiefly industrial and commercial with a minimum of disruption to existing businesses. The adjacent area, which otherwise would have been required for a part of the drainage easement, is available for development in accordance with the normal requirements of the Zoning District and building codes. Additionally, maintenance requirements (and costs) for a concrete channel are approximately one-tenth as much as for an earth channel.

The principal disadvantage of a concrete channel is that it virtually destroys the value of the channel as a scenic feature; and the wildlife values of a concrete channel are nil. The Engineer's Report (Appendix B) indicates that the initial construction costs, as well as the combined construction/maintenance costs, would be significantly higher than the proposed project.

VII. INTENDED USES OF THE EIR

The lead agency for this project is the Contra Costa County Flood Control and Water Conservation District (CCCFCWCD). The County Planning Commission will serve as the hearing body for the Environmental Impact Report. The Planning Commission will have responsibility for certifying the adequacy of the EIR as a Final EIR in compliance with CEQA. The City of Antioch and then the CCCFCWCD propose to use the certified EIR in their consideration of the future construction of all or part of the proposed project improvements.

The project facilities may be constructed in phases, beginning at the downstream end of the project and working upstream.

The following agencies may also use this EIR in their permit approval process:

1. California Department of Fish and Game
2. U.S. Department of the Army, Corps of Engineers
3. San Francisco Bay Regional Water Quality Control Board

This EIR may also be used as a data source for other environmental documents.

If the project changes substantially during the planning and approval process, an addendum, supplement, or a subsequent EIR may be necessary to address new or changed impacts.

VIII. ORGANIZATIONS AND PERSONS CONSULTED AND DOCUMENTS UTILIZED

During the preparation of an Environmental Impact Report, written and oral communications take place between the consultant and various agencies and individuals. The following is a list of contacts and documents that were utilized.

California Department of Fish and Game

Paul Kelly, Wildlife Biologist

California Natural Diversity Data Base

Suzanna Wall, Use of Services Coordinator

City of Antioch

Val Alexeeff, Senior Planner, Department of Community Development
Ron Ward, Senior Planner, Department of Community Development

Contra Costa County

Dennis Barry, Chief Data Services and Evaluation Planning Department
Jim Cutler, Chief of Comprehensive Planning Planning Department
Ed Hammil, Mapping Section, Assessors Office
Ulf Kent, Engineer, Flood Control District
Todd Nelson, Senior Planning Geologist
Steve Wright, Engineer, Flood Control District
Paul Wu, Hydrologist, Flood Control District

Corps of Engineers, U.S. Army

Herb Hereth, Chief of Hydrology
Bob Clark, Engineer

East Bay Regional Park District, Coyote Hills Regional Park

Jan Southworth

Glass Container Corporation, Antioch

Arnold Sorensen, Plant Engineer

U.S. Fish and Wildlife Service, San Francisco Bay Wildlife Refuge

Tom Harvey

SELECTED REFERENCES

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U.S.D.A. Soil Conservation Service, 1977, "Soil Survey of Contra Costa County".

IX. EIR PREPARATION AGENCY

This Environmental Impact Report was prepared by Darwin Myers Associates, under contract with Contra Costa County. The environmental analysis and report preparation was performed under the supervision of Darwin Myers. Engineers with the County Flood Control District, Steve Wright and Ulf Kent, provided insight into the hydrology of the watershed. The wildlife and vegetation section was prepared by Jim Martin, Environmental Collaborative. Research for the energy section was performed by Steve Billington, Planner.

The report was edited by Darwin Myers and Virginia Bacon. The photographs were taken by Darwin Myers. Report typing was done by Virginia Bacon.

APPENDIX A

Planning Department

County Administration Building, North Wing
P.O. Box 951
Martinez, California 94553-0095

Anthony A. Dehaesus Director of Planning

Phone 372-2035

Contra Costa County

January 11, 1984

NOTICE OF PREPARATION

ENVIRONMENTAL IMPACT REPORT FOR WEST ANTIOCH CREEK IMPROVEMENTS IN DRAINAGE AREA 55 County File #PW 83-122: A rectangular concrete channel will be constructed, meandering from the south side of the Southern Pacific Railroad to the north side of the Atchison, Topeka and Sante Fe Railroad in the general vicinity of "O" Street in the Antioch area. The project will include a multiple box culvert between Eighth Street and Tenth Street along with a silt-trap south of and a stilling basin north of the Atchison, Topeka and Sante Fe Railroad. The project is located within the City of Antioch and an unincorporated area of the County. The location is shown on Exhibit "C" and described in Exhibit "D".

As the owner of abutting property, or as an otherwise interested person or organization, you are invited to submit any comments you may have on this project, and raise any significant environmental issues of which you are aware so they can be considered in the environmental review process.

This letter plus enclosures will constitute a Notice of Preparation. Please circulate this information to the appropriate persons and agencies as soon as possible. I would encourage those interested to contact me directly by phone or letter to convey any concerns they may have. We are selecting a consulting firm to prepare an EIR; therefore, the earliest contact will ensure the best coverage of any concerns. It is hoped that the Draft EIR will be brought to public hearing at the earliest possible date.

If you have any comments on this Notice of Preparation, please contact me by February 10, 1984.

Sincerely yours,

Anthony A. Dehaesus
Director of Planning

Dennis M. Barry
Dennis M. Barry, Chief
Data Services and Evaluation

DMB/mb5a

cc: File No. PW 83-122
EIR Working File No. PW-83-122

Attachments

Contra Costa County

Public Works Department

Initial Study
OF ENVIRONMENTAL SIGNIFICANCE
NOTICE OF PREPARATION REQUIRED
File # PW-83-122

Project Name West Antioch Creek Improvement in Drainage Area 55

Public Works Department
Administration Building
Fine & Escobar Streets
Martinez, California 94553

Prepared by Steve Wright Date 1-3-84

Reviewed by Dennis M. Barry Date 1-6-84

RECOMMENDATIONS:

( )Categorical Exemption (Class)( )Negative Declaration (x)Environment Impact Report Required
( )Conditional Neg.Declaration

The Project (May)(Will Not) Have A Significant Effect On The Environment

The recommendation is based on the following (List all items identified as significant):

The project may have the significant adverse impacts listed in "Exhibit A"

What Changes To The Project Would Mitigate The Identified Impacts (List mitigation measures for any significant impacts and Conditional Negative Declaration).

SEE EXHIBIT "B"

USGS Quad Sheet Antioch North Base Map Sheet # F21, F22 G21 Parcel # N/A

GENERAL CONSIDERATIONS:

1. Location The project is located within the City of Antioch and an unincorporated area of the County. The location is shown on Exhibit "C" and described in Exhibit "D".

2. Project Description SEE EXHIBIT "E".

3. Does it appear that any feature of the project will generate significant public concern? (Nature of concern): [x] yes [ ] no [ ] maybe Construction phase impacts and effects on riparian areas and the marsh.

4. Will the project require approval or permits by other than a County agency? Agency names(s) [x] yes [ ] no City of Antioch, Dept. of Fish & Game Army Corps of Engineers

5. Is the project within the Sphere of Influence of any city? (Name) City of Antioch

ENVIRONMENTAL IMPACTS ANALYSIS:

S=Significant N=Negligible C=Cumulative No=None U=Unknown

1. Water. Will the project result in:

		S	N	C	NO	U
a)	Is any portion of the project within a Flood Hazard Area? The project area is also subject to dam inundation, however, this will have negligible impact on this aspect.	☑ YES			☐ NO	
b)	Reduction of surface or ground water quality or quantity? Only during construction since work will be conducted in the dry season and water will be diverted through or around construction areas. Minor ground water impact.	☐	☑	☐	☐	☐
c)	Increased runoff or alteration to drainage patterns and streams? Creek will be rerouted, peak runoff to marsh will increase.	☑	☐	☐	☐	☐
d)	Erosion of or sedimentation in a body of water? Potential sedimentation in marsh areas.	☑	☐	☐	☐	☐

2. Earth. (Consider the Seismic Safety Element) Will the proposal result in or be subject to:

		S	N	C	NO	U
a)	Is any portion of the project within an Alquist-Priolo Act Special Studies Zone? (if yes, date County Geologist notified ____)	☐ YES			☑ NO	
b)	Potentially hazardous geologic or soils conditions on or immediately adjoining the site? (slides, springs, erosions, liquifaction, earthquake faults; consider prime soils, slope, septic tank limitations). Cite any geologic or engineering reports. (County Geologist consulted?) High liquifaction potential. Soil in marsh is ouck, other has high shrink swell.	☑	☐	☐	☐	☐
c)	Grading (consider height amount, steepness and visibility of proposed slopes; consider effect of grading on trees, creek channels and ridge tops)(Are there any grading plans?) Creek will be enlarged and portions rerouted. Superseded portions of the creek will be filled in.	☒	☐	☐	☐	☐

3. Plant/Animal Life.

		S	N	C	NO	U
a)	Will there be a reduction or disturbance to any habitat for plants and animals? (including removal or disturbance of trees) Loss of riparian area and effect on the marsh. S.F. Bay Fish & Wildlife Habitat boundary extends southerly to south of Somersville Road.	☒	☐	☐	☐	☐
b)	Will the project affect the habitat of any rare, endangered or unique species located on or near the site?	☐	☐	☐	☑	☐
c)	What vegetation (habitat) types exist on the site (give relative % or proportions if significant)? List habitat types. Riparian area flowing through an area which is 85% urban and 15% marsh.					

4. Air. Will the Project result in deterioration of existing air quality, including creation of objectionable odors, or will future project residents be subjected to significant pollution levels? During construction.

S	N	C	NO	U
☐	☒	☐	☐	☐

5. Noise. Will the project result in:

		S	N	C	NO	U
a)	Is any portions of the project within the 1990, 60 dBA Noise Contour? (check Noise Element at 1000 scale maps)	☐ YES			☑ NO	
b)	Increases from existing noise levels? During construction.	☐	☒	☐	☐	☐

6. Energy/Natural Resources/Hazards (Consider General Plan, Safety and Seismic Safety Elements). Will the projects result in:

		S	N	C	NO	U
a)	Any additional consumption of energy? During construction.	☐	☒	☐	☐	☐
b)	Affect the potential use, extraction, conservation or depletion of a natural resource?	☐	☐	☐	☒	☐
c)	Increase risk of explosion, release of hazardous substances or other dangers to public health and safety? Continued drowning hazard	☑	☐	☐	☐	☐

7. Utilities and Public Service. Will the project:

		S	N	C	NO	U
a)	Require alteration or addition to or the need for new utility systems (including sphere of influence or district boundary change; water, sewer, solid waste)? Probably: 2 Shell pipelines north of the S.P.R.R. 1 Standard Oil pipeline south of the S.P.R.R. 1 major PG&E powerline crosses the project north of the A.T. & S.F.R.R. along the northerly extension of Somersville Road	☑ YES			☐ NO	
b)	Result in the need for new or expansion of the following services: fire and police protection, schools, parks and recreation, roads, flood control or other public works facilities, public transit or governmental services (include changes to sphere of influence)?	☐	☒	☐	☐	☐
c)	Affect recreational opportunities (consider General Plan Recreation Element-Trails Plans)? Bisects county fairgrounds.	☐	☒	☐	☐	☐

8. Transportation/Circulation. (Consider the Major Roads Plan) Will the project result in:

		S	N	C	NO	U
a)	Additional traffic generation or increase in circulation problems (consider road design, access, congestion, parking and accident potential)? During construction.	☐	☑	☐	☐	☐
b)	Special transportation considerations (waterborne, rail, air or public transportation systems and parking facilities)? None					
c)	Increase in commuting to and from local community? During construction	☐	☑	☐	☐	☐

9. Housing and Community Development. (Consider Housing Element). Is the project:

a)	Located within a Neighborhood Preservation Area? Portion	☑ YES	☐ NO
b)	Is there an opportunity for construction of low and moderate income housing?	☐ YES	☑ NO

10. Cultural Resources.

a)	Review by the Regional Clearinghouse? (their recommendation)? Letter submitted to Sonoma State on December 27, 1983	☑ YES	☐ NO Date ____
b)	Any nearby County Historic Sites (Consider Historical Resources Inventory) #284 Riverview Union High School located 75' w/o the channel near Fourth Street at Somersville Road		

11. Aesthetics. (Consider the Scenic Routes Element) Will the project obstruct any public scenic vista or view, create an aesthetically offensive site open to public view, or produce new light or glare? ☐ YES ☑ NO

12. Is this project a growth-inducing action (encourage additional requests for similar uses) or set a precedent in the area? ☑ YES ☐ NO

13. Mandatory Findings of Significance. (A "yes" answer on any of the following questions requires preparation of an EIR)

a)	Does the project have the potential to degrade the quality of the environment, or curtail the diversity in the environment?	☑ YES	☐ NO
b)	Does the project have the potential to achieve short-term, to the disadvantage of long-term, environmental goals?	☑ YES	☐ NO
c)	Does the project have impacts which are individually limited, but cumulatively considerable?	☑ YES	☐ NO
d)	Does the project have environmental impacts which will cause substantial adverse effects on human beings, either directly or indirectly?	☐ YES	☑ NO

Discussion:

		S	N	C	NO	U
b)	Result in the need for new or expansion of the following services: fire and police protection, schools, parks and recreation, roads, flood control or other public works facilities, public transit or governmental services (include changes to sphere of influence)?	☐	☒	☐	☐	☐
c)	Affect recreational opportunities (consider General Plan Recreation Element-Trails Plans)? Bisects county fairgrounds.	☐	☒	☐	☐	☐

8. Transportation/Circulation. (Consider the Major Roads Plan) Will the project result in:

a)	Additional traffic generation or increase in circulation problems (consider road design, access, congestion, parking and accident potential)? During construction.	☐	☑	☐	☐	☐
b)	Special transportation considerations (waterborne, rail, air or public transportation systems and parking facilities)? None					
c)	Increase in commuting to and from local community? During construction	☐	☑	☐	☐	☐

9. Housing and Community Development. (Consider Housing Element). Is the project:

a)	Located within a Neighborhood Preservation Area? Portion	☑ YES	☐ NO
b)	Is there an opportunity for construction of low and moderate income housing?	☐ YES	☑ NO

10. Cultural Resources.

a)	Review by the Regional Clearinghouse? (their recommendation)? Letter submitted to Sonoma State on December 27, 1983	☑ YES	☐ NO Date
b)	Any nearby County Historic Sites (Consider Historical Resources Inventory) #284 Riverview Union High School located 75' w/o the channel near Fourth Street at Somersville Road		

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12.	Is this project a growth-inducing action (encourage additional requests for similar uses) or set a precedent in the area?	☑ YES	☐ NO

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a)	Does the project have the potential to degrade the quality of the environment, or curtail the diversity in the environment?	☑ YES	☐ NO
b)	Does the project have the potential to achieve short-term, to the disadvantage of long-term, environmental goals?	☑ YES	☐ NO
c)	Does the project have impacts which are individually limited, but cumulatively considerable?	☑ YES	☐ NO
d)	Does the project have environmental impacts which will cause substantial adverse effects on human beings, either directly or indirectly?	☐ YES	☒ NO

Discussion:

PROPOSED SCOPE FOR THE

DRAFT ENVIRONMENTAL IMPACT REPORT

FOR THE

WEST ANTIOCH CREEK IMPROVEMENTS IN DRAINAGE AREA 55

CONTRA COSTA COUNTY, CALIFORNIA

The West Antioch Creek Improvements Project, it's impacts and changes to the project which mitigate some of the impacts are described in the attached Initial Study and it's exhibits.

The Draft Environmental Impact Report will focus on the environmental impacts listed below, the project alternatives described in Attachment "F" and other items required for a focused Draft Environmental Impact Report under the California Environmental Quality Act.

1. The significant adverse impacts identified in Exhibit "A" of the Initial Study.

2. Significant adverse impacts identified in comments received through the Notice of Preparation process.

Other impacts evaluated in the Initial Study which were determined to have negligible impacts will not be evaluated further.

EXHIBIT "A"

SIGNIFICANT ADVERSE IMPACTS

... Removal of, and impacts on, riparian areas, marsh areas and aquatic wildlife.

... Temporary exposure of residents, businesses and development, to increased levels of noise at the site and along major haul routes during construction.

... Potential loss of, and impact on, cultural resources.

... Construction of new facilities in areas subject to high liquefaction potential.

... Continued drowning hazard from the proposed drainage facilities.

... Increased erosion, sedimentation and reduction in surface water quality during construction.

... Potential growth inducement.

... Visual impact of rectangular concrete channel.

... Potential utility conflicts.

... Potential impacts on structure of historic significance.

EXHIBIT "B"

POSSIBLE CHANGES TO THE PROJECT WHICH WOULD MITIGATE IDENTIFIED SIGNIFICANT IMPACTS

SHORT-TERM IMPACTS

... Conduct excavation, hauling and other construction operations only on weekdays during normal working hours where they may disturb residents and noise sensitive development.

... Select haul routes and disposal sites which minimize noise and traffic impacts on residents and noise sensitive development.

... During the construction phase locate stationary, noisy equipment, such as air compressors and motor generator sets, as far as possible from residences and noise sensitive development.

... Performing construction work during the summer dry season and seed bare slopes to minimize erosion and downstream sedimentation.

... Construct temporary sediment traps.

LONG-TERM IMPACT

... Plant and maintain trees and shrubs to provide visual buffering and screening.

... Utilize native drought-tolerant vegetation for all landscaping to reduce water requirements and to provide better habitat for native wildlife.

... Incorporate design elements which will minimize erosion, sedimentation and reduction of surface water quality.

... Leave areas which have important cultural resources in their natural state or proceed with construction under the direction of a qualified archaeologist.

... Stop work in the vicinity of any cultural feature such as human interments or artifacts encountered during construction, and consult an archaeologist for a determination of procedures to be followed.

... Design facilities for existing soils and geologic conditions.

... Limit public access to drainage facilities by fencing open channels.

EXHIBIT "D"

PROJECT LOCATION

The downstream end of the project is located at a slough in the marsh area on the north side of the Atchison, Topeka & Santa Fe Railroad right-of-way approximately 800 feet west of the northerly extension of "O" Street. The project meanders southerly to Somersville Road; southeasterly to 200 feet west of "O" Street at Sixth Street; southerly to Eighth Street; southeasterly to Tenth Street at the west side of "O" Street; southerly to Markley Creek just north of the Southern Pacific Railroad right-of-way; southeasterly along the railroad to the northerly extension of West Antioch Creek between Manzanita Way and Lemon Tree Way; and then under the railroad right-of-way to the inlets to the proposed system. The project includes approximately a 100-foot conform from West Antioch Creek to Markley Creek.

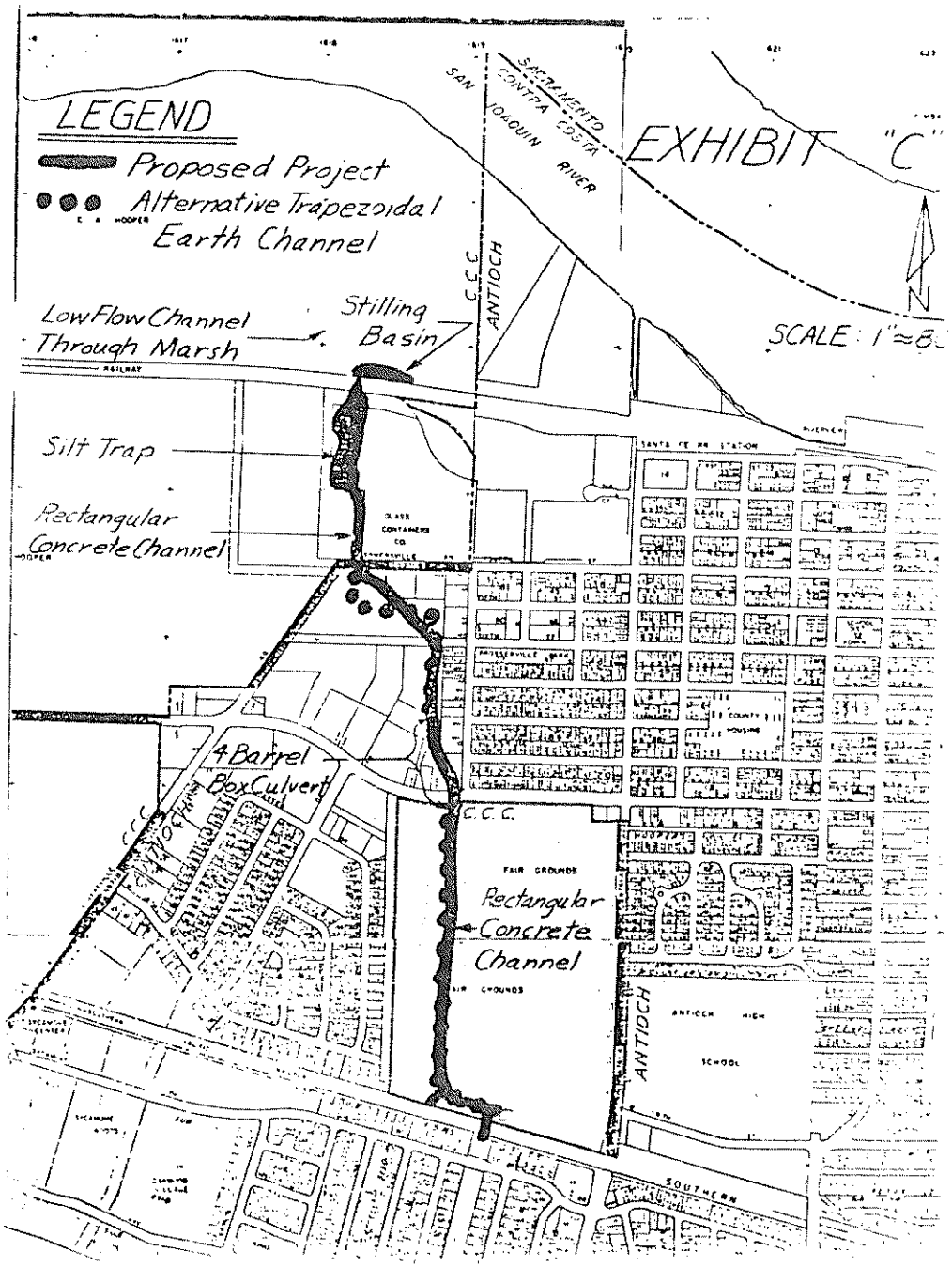


EXHIBIT "E"

PROPOSED WEST ANTIOCH CREEK IMPROVEMENTS

DRAINAGE AREA 55

PROJECT DESCRIPTION: This project will reduce flooding potential by providing greater channel and culvert capacity. The project will involve the improvements approximately described below including, but not limited to, construction of transitions between culverts and channel sections; junction structures; conforms between the top of the bank of the channel and existing ground level; erosion control; slope protection; inlets, manholes; outfall structures; installation of fences; pipes; culverts; removal, modification and/or relocation of utilities; and acquisition of required rights-of-way and easements as required for the final improved drainage facility.

1. An outfall into the slough at the Marsh area at the north side of the Atchison, Topeka and Santa Fe Railroad right-of-way approximately 800 feet west of the northerly extension of "O" Street.

2. A stilling basin on the north side of the AT & S.F. Railroad right-of-way.

3. Excavate silt trap from the A.T. & S.F. Railroad to 750 feet southerly.

4. A 4-barrel box culvert under Somersville Road. Each barrel will be approximately 12 feet wide and 7 feet high.

5. A rectangular concrete channel 50 feet wide and 7 feet to 11 feet deep from the silt trap southerly to the westerly extension of Eighth Street.

6. A 4-barrel box culvert from the westerly extension of Eighth Street to 50 feet south of Tenth Street.

7. A rectangular concrete channel 30 feet to 50 feet wide and 7 feet to 11 feet deep from 50 feet south of Tenth Street to the Markley Creek junction at the northerly side of the Southern Pacific Railroad.

8. A rectangular concrete side channel 20 feet wide and 7 feet to 11 feet deep will extend 100 feet from West Antioch Creek to Markley Creek.

9. A rectangular concrete channel 30 feet wide and 7 feet to 11 feet deep from West Antioch Creek's confluence with Markley Creek, southeasterly along the north side of the Southern Pacific Railroad to the northerly extension of West Antioch Creek between Manzanita Way and Lemon Tree Way.

10. Three 96-inch pipes under the Southern Pacific Railroad right-of-way to inlet structures in the upstream channel of West Antioch Creek.

ATTACHMENT "F"

ALTERNATIVES

The following alternatives provide flood protection comparable to that of the proposed project. They involve the improvements approximately described below including, but not limited to, construction of transitions between culverts and channel sections; junction structures; conforms between the top of bank of the channel and existing ground level; erosion control; slope protection; inlets; manholes; outfall structures; installation of fences; pipes; culverts; removal, modification and/or relocation of utilities; and acquisition of required rights-of-way and easements as required for the final improved drainage facility.

ALTERNATIVE 1: Earth channel with slope protection where necessary to minimize erosion.

a) Project limits:

1. Somersville Road to westerly extension of Eighth Street.

2. Just south of Tenth Street to the S.P.R.R. right-of-way including the junction with Markley Creek.

b) Alignment: approximately along project alignment except alternative may vary 250 feet southwesterly of project alignment between Somersville Road and Seventh Street.

ALTERNATIVE 2: No project.

APPENDIX B

ENGINEER'S REPORT

FOR

IMPROVEMENTS ON LOWER WEST ANTIOCH CREEK

CONTRA COSTA COUNTY SERVICE AREA D-3

PREPARED BY
THE STAFF OF THE
CONTRA COSTA COUNTY FLOOD CONTROL
AND
WATER CONSERVATION DISTRICT
255 Glacier Drive
Martinez, CA 94553

June 1984

TABLE OF CONTENTS

1. RECOMMENDATION

It is recommended that the Contra Costa County Board of Supervisors confirm that improvements to lower West Antioch Creek are needed and amend the plan for County Service Area D-3 by adopting Alternate 2, presented in this report, as the plan of improvements, eliminating the outfall channel through the marsh and using earth channels instead of concrete lined channels where the present level of urbanization permits.

2. INTRODUCTION

In 1971, County Service Area D-3 was formed to allow the collection of drainage fees for the construction of improvements of West Antioch Creek between the San Joaquin River and the Mokelumne Aqueduct. Except for several sections of channel upstream of the Southern Pacific Railroad which have been improved as part of subdivision developments, West Antioch Creek has remained unimproved. The following report will reiterate some of the material contained in the Engineer's Report for County Service Area D-3, but the main focus will be on the proposed creek improvements between the San Joaquin River and the Southern Pacific Railroad.

3. SERVICE AREA LOCATION AND DESCRIPTION

County Service Area D-3 is located in Northeastern Contra Costa County. The Service Area includes the westerly portion of the City of Antioch and several square miles of unincorporated land to the southwest of the City. The Service Area boundary was established to follow as closely as possible the West Antioch Creek Watershed boundary. In general, the Service Area extends from the San Joaquin River southerly to a ridge in the vicinity of the old Somersville coal mines. County Service Area D-3 comprises an area of about 8,000 acres. Existing land use is divided between agricultural, industrial, commercial and residential. The northerly portion of the Service Area is a relatively flat alluvial plain with typical bay tidelands adjacent to the San Joaquin River. Development in this portion has been mainly industrial and commercial. Additional developments of this type are expected in this portion of the Service Area due to the availability of undeveloped industrial property. The southerly portion of the Service Area consists of rolling hills and ridges which rise to an elevation of 1,500 feet. This portion of the watershed is mainly residential and agricultural in nature, with commercial development primarily in the retail sales and service areas. In recent years, the rate of residential development has increased. In view of the countywide demand for new housing, it is expected that the present rate of residential development will continue. The proposed improvements are located in the northerly portion of the Service Area, between the AT & SF and the Southern Pacific Transportation Company lines.

4. EXISTING AND FUTURE FLOODING PROBLEMS IN THE AREA OF THE PROPOSED IMPROVEMENTS

West Antioch Creek, in its existing state, is an earth ditch, approximately 8 to 10 feet wide at the bottom, and banks sloped at 1:1 to 1½:1, horizontal to vertical. The creek is on a shallow grade, prone to siltation and passes under railroads and roads via culverts and bridges which appear inadequate to pass annual peak winter runoff. The creek, culverts, and bridges are

in a condition which will cause severe flooding in the area as the watershed continues to develop. Flooding has occurred recently on the Fairgrounds and in the residential area along "O" Street.

The Glass Container Company to the north of Somersville Road was flooded in 1982 and, had it not been for sandbagging, would have been again in 1983.

An economic assessment of the flood damage, in terms of the costs of the repairs, loss of business, etc., has not been made. However, the Glass Container Company apparently lost $750,000 to the 1982 flood alone.

As the watershed continues to develop and upstream drainage systems are improved, it has been computed that storm water which discharges into the area of the proposed improvements will more than double. The resulting flooding will cause heavy damage, not only to commercial and industrial operations, but also to the residential area easterly of the creek.

5. BENEFITS OF THE PROPOSED IMPROVEMENTS

The proposed improvements would be able to pass storm water runoff due to the 100-year and 50-year storm with approximately one foot and two to three feet of freeboard, respectively. Local drainage would be able to enter the creek even at high creek flows.

At present, the creek flows appear to carry a high silt load. This silt is deposited in the marsh area and the San Joaquin River. The proposed improvements include a siltation basin immediately upstream (south) of the AT&SF Railroad which allows the silt to settle in that specific area rather than being deposited in the marsh and river.

The improvements include provisions to pass the runoff from a 100 year storm through the Southern Pacific Railroad embankment on West Antioch Creek. At present, the culvert under the railroad embankment is less than one-third of the size required to pass the expected flows. The proposed improvements would reduce the threat of flooding in the residential area upstream of the culvert between the railroad embankment and State Highway 4.

6. THE PROPOSED CREEK IMPROVEMENTS

The flood plain within which the proposed improvements are located rises very gradually from the marsh over most of its length. The upper watershed is hilly and thus generates a large volume of storm drainage runoff. This, together with high tides and high river flows, makes it very difficult to drain the area within which the improvements are proposed. The improvements have to provide for a large flow capacity at shallow flow depths due to vertical constraints at the Fairgrounds, 10th Street, and the car dealership immediately to the north, and the elevations of the marsh.

The above conditions do not permit creek improvements such as widening the existing ditch and/or supplementing it with a channel or pipe system of modest dimensions. It appears that there are only two types of creek improvements feasible for the area. These are called Alternate 1 and Alternate 2 in the following descriptions and appendix.

6.1 Alternate 1 - Rectangular Concrete Channel

This alternate is a rectangular concrete channel for most of its length with an earth stilling basin and outlet pond at its outfall. More specifically, the proposed improvements are the following:

North of the AT&SF Railroad:

An outlet pond, approximately 2-3 feet deep, is planned in the marsh area. Side slopes vary between 3:1 and 5:1, horizontal to vertical. Low flows pass northwesterly through a break in the pond into an existing slough toward the river. High flows will rise above the pond and spread into the marsh at low velocity. At high tide or river stage, the pond is filled to the level of the tide or river stage.

South of the AT&SF Railroad to a Point 600 Feet Upstream:

The existing railroad bridge is to remain "as is," but the opening will be enlarged to its maximum capacity. Upstream of the bridge, a stilling basin is proposed, approximately 600 feet long and 170 feet wide. This area is to serve both as an energy dissipator for flows from the rectangular channel and as a sedimentation basin. Removal of the sediment from the basin will be done from the easterly side where a storage area is provided to allow the dredged material to drain and partially dry prior to being trucked to an upland disposal area.

From a Point 600 Feet Upstream of the AT & SF Railroad to the Northerly Edge of the Car Dealership at 10th Street:

A 50-foot wide by 9.5-foot high rectangular concrete channel is proposed from the stilling basin to the car dealership near 10th Street. The culvert under Somersville Road is proposed to be a reinforced concrete box culvert, with four 12-foot wide by 8-foot high barrels. Maintenance access to the bottom of the concrete channel is provided by means of a ramp from Somersville Road. The total right-of-way width of the concrete channel is 64 feet. This width provides for a 6-foot wide maintenance inspection foot path on both sides of the channel. Provisions to insure channel safety include a safety rail on top of the channel wall and chain link fencing at the edge of the right-of-way.

The existing creek, between Somersville Road and 6th Street, and where it parallels Somersville Road, is to be abandoned. The improved channel bypasses the existing creek on a shorter, more direct alignment. In anticipation of this project, the Flood control district purchased a 150-foot wide strip of land, on a direct alignment, between Somersville Road and the car dealership.

The Area of the Car Dealership and 10th Street

The existence of the parking lot, buildings, and 10th Street and its improvements make any attempt to raise the ground in this area very costly. The existing creek is underground for the most part in this area and the proposed

improvements also envision a closed culvert. The proposal is to install a four-barrel (12-foot wide by 7-foot high each) reinforced box culvert under the parking lot and 10th Street. The width of the downstream channel makes the installation of this low culvert possible, but even at that, some reshaping of the parking lot and 10th Street is anticipated.

Between 10th Street and the Junction with Marklee Creek:

The restrictions on water depth in the vicinity of the Southern Pacific Railroad are not as stringent as those at the 10th Street area and downstream. Thus, a 40-foot wide by 9.5-foot deep reinforced concrete channel is possible in this area. The proposed channel is on the same alignment as the existing creek which it will replace.

There are several existing vehicular and pedestrian access bridges across the creek in the Fairgrounds area. It is proposed that each of these crossings be replaced with three-barrel (14-foot wide by 8-foot high each), reinforced concrete box culverts. Other bridge types (clear span concrete, steel or wood) may be used as long as a vertical clearance of 8 feet is maintained.

The total right-of-way width of the concrete channel is 54 feet. This width, just as it was the case in the 50-foot wide channel in the area downstream, provides for inspection foot paths. Safety rail and fencing is the same as for the downstream channel.

From the junction with Marklee Creek through the Southern Pacific Railroad:

Marklee Creek contributes approximately 27 percent of the total flow downstream of the junction. The resulting reduced flow in West Antioch upstream of the junction makes it possible to reduce the size of the rectangular channel. A 28-foot wide rectangular reinforced concrete channel is proposed with walls which vary in height between 8.5 feet and 11.5 feet. At the point where the 96-inch diameter pipe culverts enter the proposed channel, a maintenance access ramp is proposed to the channel bottom.

The right of way necessary for the project varies from 54 feet downstream of the junction to approximately 40 feet in the upstream portion of the channel. The westerly inspection foot path is discontinued at the junction, while the easterly path is continued until the channel ends.

Safety rail and fencing are the same as those for the channel downstream of the junction, except that the westerly safety rail is, as the foot path, discontinued at the junction.

The culvert under the Southern Pacific Railroad is to consist of three 96-inch diameter reinforced concrete pipes. These pipes are proposed to be jacked through the railroad embankment without interference with railroad operations. The upstream end of these pipes terminates in a reinforced concrete box, 38 feet wide by 12 feet deep by 10 feet high. The water surface due to runoff from the 100 year storm immediately upstream of the box inlet has been computed as being 2 feet below the top of bank. Access to the inlet box is proposed from the existing creek access strip downstream of Sycamore Drive.

The right-of-way requirements for the rectangular channel and the inlet box do not affect the Southern Pacific Railroad Company. The three culvert pipes, however, do affect the Company since a permanent underground easement is required for this installation.

Marklee Creek

Marklee Creek is an existing earth ditch parallel to the Southern Pacific Railroad, then, as it passes under the railroad via a pipe culvert, becomes a substantial natural creek in its upper reaches.

Under the proposed improvements, only a short section of the creek is to be improved at this time. It is anticipated that more of this creek will be improved in the future but more on an "as needed" basis.

The proposed improvements consist of a 10-foot wide by 9-foot deep reinforced concrete channel with a rock conform channel to the existing creek. The entire improvement of Marklee Creek is approximately 180 feet long.

Safety rail and fencing are proposed to be the same as for West Antioch Creek upstream of the junction. Right-of-way requirements will not affect the Southern Pacific Railroad.

Advantages of Alternate 1

Alternate 1 requires the least possible right-of-way of any type of improvements.

Maintenance costs within the concrete channel will be minor. Repair activities, if necessary, will be minimal and out of view in the channel.

Disadvantages of Alternate 1

High initial project costs.

Safety fencing will be visible.

Riparian vegetation and wildlife, as it may exist at this time, will be lost without a chance of reestablishment within the concrete channel.

Costs of Alternate 1 (1985 Prices)

Construction and Utility Relocations	$5,500,000
Right-of-Way Acquisition	$200,000
Administration, Engineering and Contingencies	$1,900,000
Total Project Cost	$7,600,000

6.2 Alternate 2 (Earth Channel)

This alternate is a trapezoidal earth channel for most of its length, including a short reach of rectangular concrete channel downstream of Somersville Road with an earth stilling basin and outlet pond at its outlet end. More specifically, the proposed improvements are as follows:

North of the AT&SF Railroad:

Same as Alternate 1.

From South of the AT & SF Railroad to a point 600 feet upstream:

Same as Alternate 1.

From 600 feet Upstream of the AT&SF Railroad to the Northerly edge of the Car Dealership at 10th Street:

From the southerly face of the proposed culvert at Somersville Road to the stilling basin downstream, the proposed improvements are of the same character as those for Alternate 1. The structures proposed under Alternate 2 are wider, i.e. the rectangular channel is 68 feet wide by 7.5 feet deep and the culvert under Somersville Road is required to be a four barrel (15-foot wide by 7-foot high each) reinforced concrete box culvert.

A trapezoidal earth channel is proposed upstream of Somersville Road to the car dealership. Its alignment essentially follows that of Alternate 1 and the existing right-of-way. The proposed channel is 90 feet wide at the bottom. The easterly channel maintenance road (20 feet wide) is located 2.5 feet above the channel bottom (making the channel bottom region approximately 110 feet wide). It is recognized that this exposes the access road to erosion and non-use except for the summer months. Hydraulically, however, the channel width is needed to retain a water depth that will not flood the area around 10th Street. The proposed channel side slopes are 2:1, horizontal to vertical. It is proposed that the undeveloped land to the west of the channel be filled to elevation 13.5 minimum. Since the presence of roads and buildings to the east of the channel prohibits filling, it is proposed to install a 2-foot high concrete flood wall along most of the easterly edge of the channel improvements. The westerly maintenance access road will be at the level of the existing land.

The District owns a 150 feet wide strip of right-of-way between Somersville Road and the car dealership. The proposed earth channel is located in such a way that the additional required right-of-way (a 20 to 40-foot wide strip) would be taken along the westerly, undeveloped side.

The hydraulic parameters used for the earth channel improvements include a frictional resistance value of n=0.040. This anticipates that a certain amount of natural revegetation, in addition to the native grasses planted as part of the project, will be tolerated within the waterline. The improvements as proposed make no provisions for fencing except in the area of the concrete channel (where safety rail and fencing is the same as for Alternate 1) and along concrete walls where the earth channel transitions into a culvert.

As in Alternate 1, portion of the existing creek is bypassed by the proposed improvements. This area could be filled and made usable by its owners.

The Area of the Car Dealership and 10th Street:

The hydraulic problems in this area were mentioned under Alternate 1. As in the area downstream, a wider culvert is required for Alternate 2, namely a four-barrel (14-foot wide by 7-foot high each), reinforced concrete box culvert.

Between 10th Street and the Junction with Marklee Creek:

In this reach, the westerly portion of the Fairgrounds is extremely low except near the Southern Pacific Railroad, while the easterly portion contains a road next to the creek. Hydraulic considerations for freeboard protection were adopted from the Corps of Engineers' criteria. Essentially it says that, if the computed water surface for the runoff due to the 100 year storm is above existing ground level and levees are required, such earth levees must reach 3 feet above, and concrete walls 2 feet above, this computed water surface.

In accordance with the above criteria, the proposed improvements consist of an 80-foot wide earth channel with side slopes of 2:1, horizontal to vertical. The westerly side includes an earth levee, ranging in height between 3.5 feet and 5.5 feet, while the easterly side includes a 2-foot to 3-foot high concrete flood wall.

Maintenance access is proposed by means of a levee road to the west, and the existing access road to the east of the improvements.

Provisions for revegetation and fencing are the same as for the earth channel downstream of 10th Street.

As in Alternate 1, the existing vehicular and pedestrian access bridges to the Fairgrounds buildings are to be replaced. It is proposed to construct four barrel (20-foot wide by 8-foot high each), reinforced concrete box culvert crossings. Other types of bridges will do as well but the 8 feet vertical clearance must be maintained.

Junction with Marklee Creek through the Southern Pacific Railroad:

As in Alternate 1, the channel upstream of the junction can be reduced to a 34-foot bottom width. Side slopes are 2:1, the same as for the channel downstream. The high railroad embankment and ground surface in its vicinity makes the construction of levees and/or flood walls unnecessary. Maintenance operations are proposed to be done from one side (opposite the railroad) only.

The culverts through the Southern Pacific Railroad embankment and the inlet box at the culverts' upstream end are the same as for Alternate 1.

Marklee Creek:

As in Alternate 1, only the outlet section of Marklee Creek is proposed for improvement. The improvements are to consist of approximately 200 linear feet of rock-lined trapezoidal channel of 10-foot bottom width, 9 to 10-foot depth with side slopes of 2:1, horizontal to vertical.

The maintenance access road along West Antioch Creek downstream of the junction is continued along the Marklee Creek Improvements, terminating in a turn-around at the end. Maintenance operations are proposed to be conducted from one side only.

Advantages of Alternate 2

The initial project costs are less for Alternate 2 than for Alternate 1.

Alternate 2 provides a corridor of open space which has the potential to become visually pleasing and environmentally effective.

Disadvantages of Alternate 2

Alternate 2 requires more right-of-way than Alternate 1.

The earth channel portion of Alternate 2 is prone to erosion and the rapid spread of vegetation. The maintenance effort in channel repair and vegetation removal is anticipated to be costly.

Costs of Alternate 2 (1985 Prices)

Construction and Utility Relocations	$4,200,000
Right of Way Acquisitions	$350,000
Administration, Engineering and Contingencies	$1,450,000
Total Project Cost	$6,000,000

7. MAINTENANCE OF IMPROVEMENTS

Maintenance activities for either Alternative would consist of removing sediments from the outlet pond and stilling basin and trimming excessive vegetal growth in those areas; removing sediments and trash from the channel upstream of the stilling basin, doing concrete repair work and repairing safety railing and fencing.

Alternate 2 would require additional maintenance work, consisting of earth and rock channel repair, removing excessive vegetal growth from the channel bottom and sides and doing landscape repair and maintenance. The amount of additional work is influenced by natural circumstances, e.g., rainfall, tides, resulting in potentially high maintenance expenses.

A table, showing estimated annual maintenance costs for both areas, is on the following page:

ESTIMATED ANNUAL MAINTENANCE COSTS

Alternate	Location	Type of Work	Cost
1	Outlet Pond and Stilling Basin	Sediment Removal and vegetative trimming	$ 8,000
	Stilling Basin to Somersville Rd.	Concrete and fence repair sediment removal	$ 1,500
	Somersville Rd. to End of Project	Concrete and fence repair	
		Landscape Maintenance	$ 2,000
		trash removal	$ 2,500
		TOTAL ANNUAL MAINTENANCE COST:	$14,000
2	Outlet Pond and Stilling Basin	Sediment Removal and vegetative trimming	$ 8,000
	Stilling Basin to Somersville Rd.	Concrete and fencing repair, sediment removal	$ 1,500
	Somersville Rd. to End of Project	Concrete and fence repair	$ 500
		trash and sediment removal	$ 5,000
		channel repair	$10,000
		vegetation control	$ 2,500
		landscape maintenance	$ 3,000
		TOTAL ANNUAL MAINTENANCE COSTS:	$31,000

NOTE: These annual maintenance costs have not been made part of the cost estimates for Alternates 1 and 2.

If the work is done with federal assistance, the Flood Control District will assume the maintenance responsibilities for the entire project. If the work is done with local financing, the maintenance responsibility will probably be shared by the District and the City of Antioch within their respective jurisdictions. Since County Service Area D-3 does not benefit from property taxes, Special District Augmentation financing will be needed for the maintenance of the major channel portion of the system.

8. RECOMMENDATIONS AND DISCUSSION OF THE RECOMMENDED ALTERNATE

In view of the factors investigated and presented in this report, Alternate 2 is recommended for implementation.

Alternate 2 is acceptable environmentally, i.e. earth channel replaces earth ditch with enhanced potential for flourishing plant and wildlife. Alternate 2 is also considerably more economical than Alternate 1. However, there are two intangibles which may affect the above recommendation:

1. Land use in the area is anticipated to be entirely industrial and commercial. Will the business community in the area support a project with a high right-of-way demand such as Alternate 2?

2. Earth channels which are open to backflows from rivers and tidal basins vegetate profusely. While this is productive environmentally, it is counterproductive with respect to maintaining flow capacity and erosion control. Such vegetation must be held in check annually, otherwise the occasional removal of vegetation and channel repair can cost many times more than anticipated.

3. Excessively wet and dry years and high levels of vandalism can cause higher maintenance costs for earth channels.

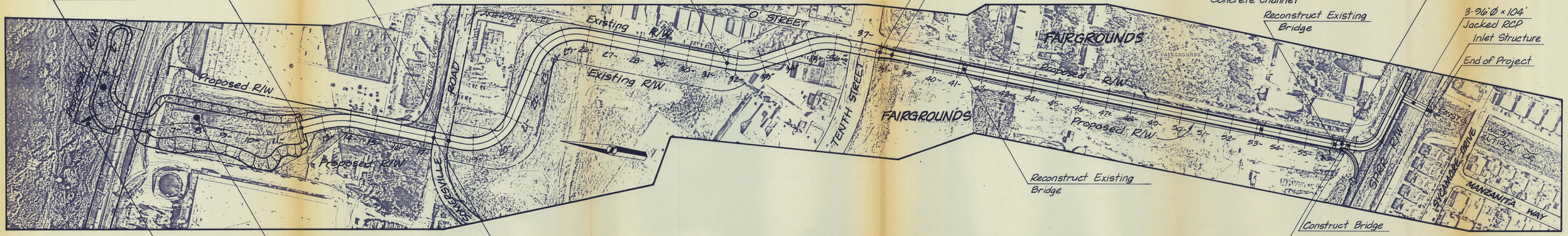
9. METHOD OF FINANCING

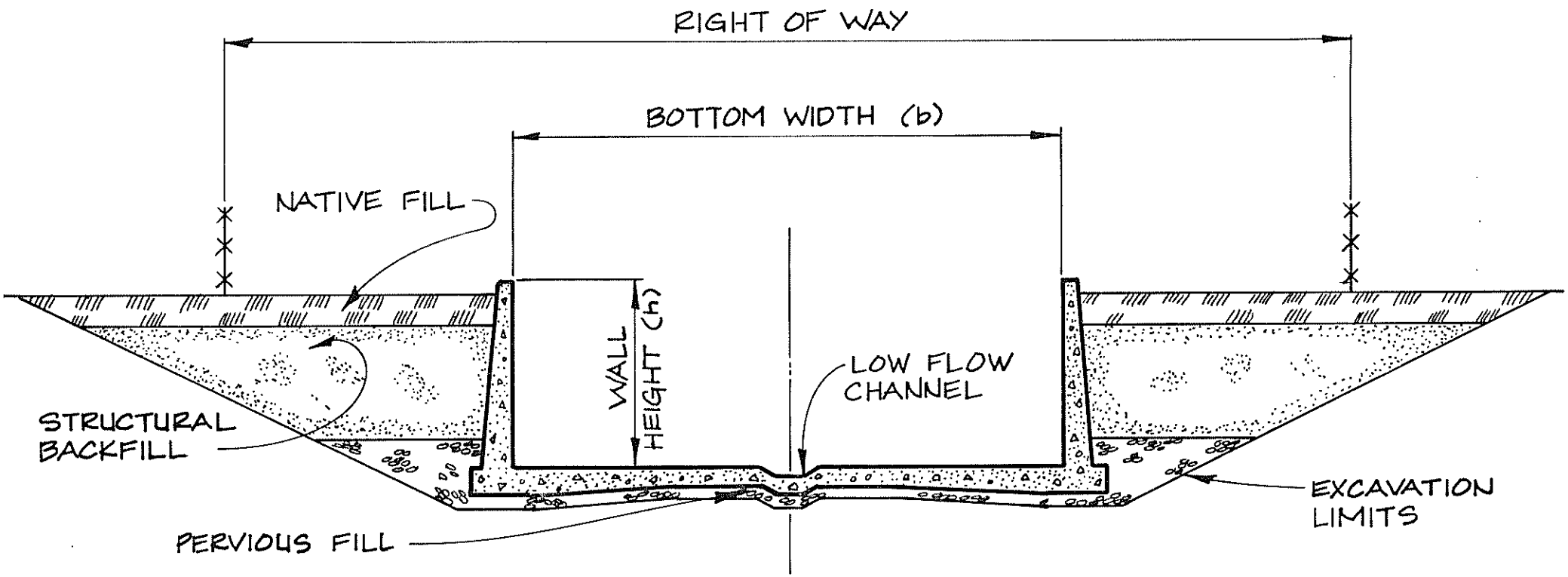
The County Service Area D-3 drainage fees compose only a small fraction of the total cost for the improvements. It is therefore the District's intention to ask for federal participation in the improvements. If such assistance can be secured, the drainage fees collected under the Service Area's provisions may be used to pay for the local share of the project costs.

If federal assistance cannot be secured, the project might be done in part with Service Area fees, conditions of development, and participation by the City of Antioch, the County and property owners in terms of right of way and/or monetary donations and donations of construction effort.

ALTERNATE 1 - CONCRETE CHANNEL

Approximate Scale: 1" = 160'



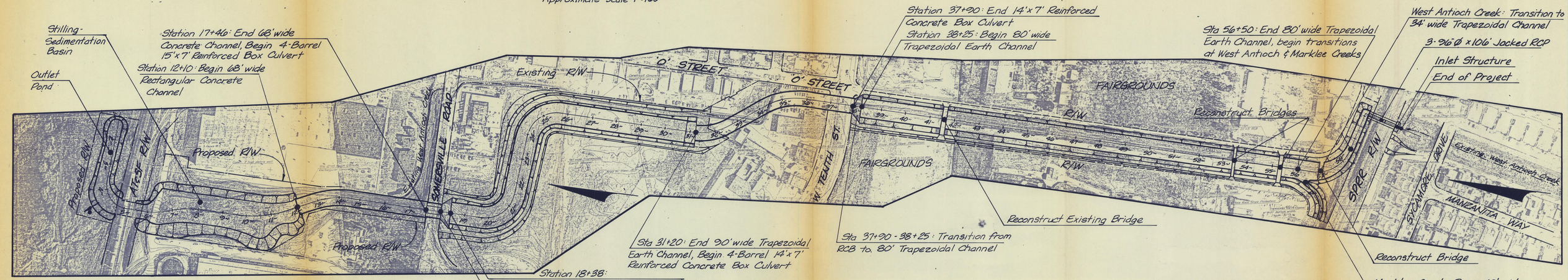


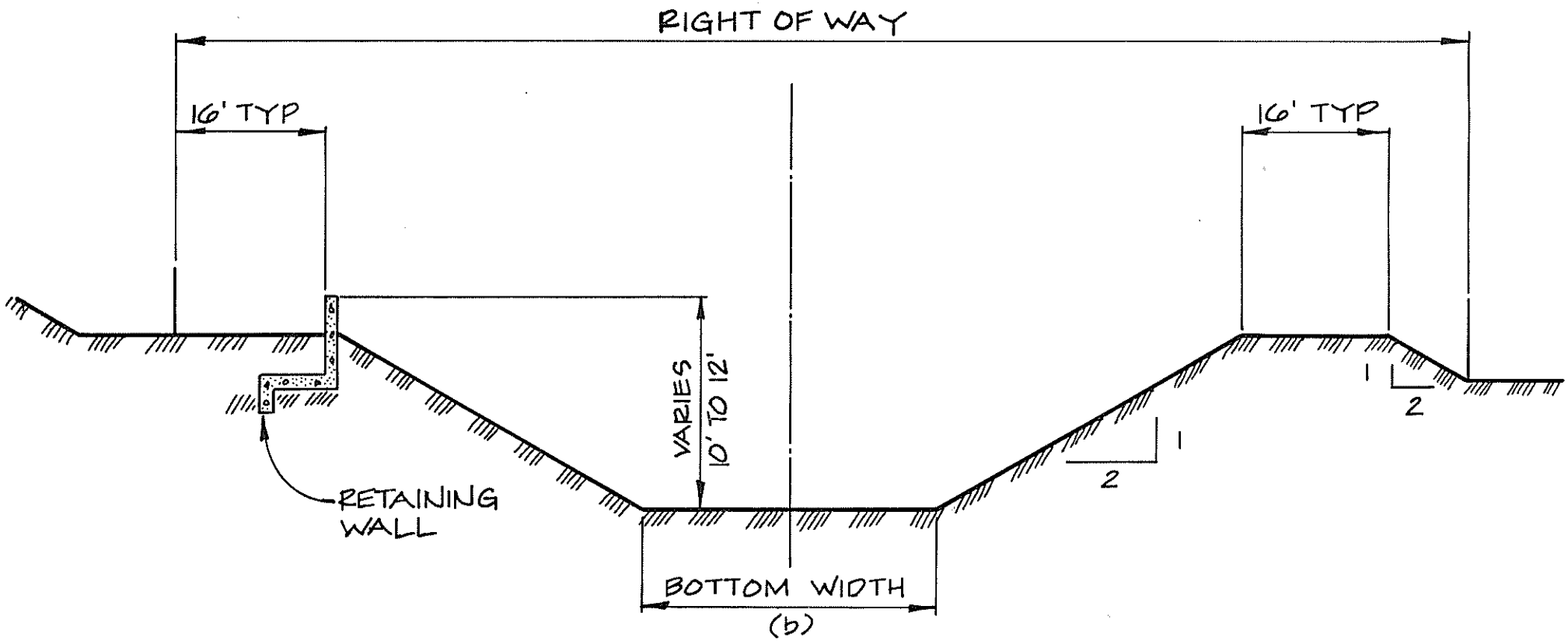
TYPICAL SECTION
RECTANGULAR CONCRETE CHANNEL

NOT TO SCALE

ALTERNATE 2 - EARTH CHANNEL

Approximate Scale: 1"=160'





TYPICAL SECTION

TRAPEZOIDAL EARTH CHANNEL

NOT TO SCALE

APPENDIX C

...e of California THE RESOURCES AGI

Memorandum

To : Department Directors, Executive Officers of Boards & Commissions

Date : SEP 1 9 1977

File No.:

Subject: Wetlands Policy fo Proposed Construction Pr

From : Office of the Secretary

POLICY FOR PRESERVATION OF WETLANDS IN PERPETUITY

The need to raise thinking, policy, and action to the ecosystem level is especially evident as it relates to proposed construction projects on Wetlands of the state.

The value of marshlands and other wetlands to the economy and to the overall long-term quality of life, has been described by many, including Gosselink, Odum, and Pope (1973) in "The Value of the Tidal Marsh"; the Bay Conservation and Development Commission, (BCDC) in, "The San Francisco Bay Plan"; and the Department of Fish and Game in, "The Fish and Wildlife Plan". In spite of these and other efforts, filling and other destruction of the State's wetlands has continued at an alarming rate. Most of San Francisco Bay's wetlands are now protected by BCDC. But before the commission came into existance over 225 square miles of Bay wetlands had been filled or destroyed. Still not all of the Bay's wetlands are protected. Over 40,000 acres are not in the commission's jurisdiction.

Portions of other important wetlands still exist along the coast, its estuaries, the Sacramento-San Joaquin Delta and along several natural bodies of water including Clear Lake, the Colorado River and others. Many of these wetlands are not under permit authority from a specific State agency. However, local authority and sometimes federal authority (Corps of Engineers) exists over specific projects and areas.

It is the purpose of this memorandum to establish a basic wetlands policy to be observed by all Departments, Boards, and Commissions of the Resources Agency when developing projects or when authorizing

or influencing private or public projects and permit actions taken by other authorities including federal, state and local agencies.

BASIC WETLANDS PROTECTION POLICY

It is the basic policy of the Resources Agency that this Agency and its Departments, Boards and Commissions will not authorize or approve projects that fill or otherwise harm or destroy coastal, estuarine, or inland wetlands.

Exceptions to this policy may be granted provided that the following conditions are met.

1. The proposed project must be water dependent or an essential transportation, water conveyance or utility project.

2. There must be no feasible, less environmentally damaging alternative location for the type of project being considered.

3. The public trust must not be adversely affected.

4. Adequate compensation for project-caused losses shall be a part of the project. Compensation, to be considered adequate, must meet the following criteria:

   a. The compensation measures must be in writing in the form of either conditions on a permit or an agreement signed by the applicant and the Department of Fish and Game or the Resources Agency.

   b. The combined long-term "wetlands habitat value" of the lands involved (including project and mitigation lands) must not be less after project completion than the combined "wetlands habitat value" that exists under pre-project conditions.

Huey D. Johnson
Secretary for Resources

APPENDIX D

CALIFORNIA DEPARTMENT OF FISH AND GAME
SAN FRANCISCO BAY MANAGEMENT GUIDELINES
FROM "PROTECTION AND RESTORATION OF SAN FRANCISCO BAY FISH AND WILDLIFE HABITAT"1/

The overall intent of this report is to provide local, state, and federal planning and regulatory agencies the position of the Department toward protecting and restoring historical wetlands of San Francisco Bay. Accordingly, the following guidelines will be applied by the Department in critically evaluating any project proposed within the study area whose implementation may adversely affect the areas delineated in the report as having value for fish and wildlife. A variance to the guidelines may be considered if such variance would result in a greater benefit to fish and wildlife than if the guidelines were followed.

The Department of Fish and Game will provide the State's viewpoint on fish and wildlife matters relative to federally constructed or permitted projects within the historic marsh margin of the Bay.

1. All areas of historical tidal marsh should be restored to productive fish and wildlife habitat wherever feasible.

2. Existing agricultural uses within the historic marsh margin and adjacent areas are compatible with habitat protection objectives and are encouraged to continue. Upon cessation of such uses, those areas should be restored or upgraded to the highest habitat value for the fish and wildlife of the Bay.

3. Ruderal and other undeveloped areas adjacent to existing wetlands should be preserved as open space for wildlife, with recreation uses encouraged, consistent with protection of wildlife habitat values.

4. Development in wetlands may be permitted if such development is dependent upon a waterfront site, provided that there are no other less environmentally damaging alternatives. Additionally, only those portions of projects which are actually water-dependent will be permitted.

1/ Prepared by Jones and Stokes, Harvey and Stanley and John Blayney Associates with the U. S. Fish and Wildlife Service and the California Department of Fish and Game — August 1, 1977.

5. The net volume and tidal surface of the Bay should not be reduced by permitted development. Any reduction in surface or volume should be offset by restoration of a comparable area in terms of size and value to fish and wildlife.

6. Permitted development on diked but unfilled historic marsh which results in permanent loss of an area having potential fish and wildlife habitat values must be offset by restoration of an area of comparable size and value.

As authorized by the U. S. Fish and Wildlife Coordination Act, NEPA, CEQA, and other appropriate laws and regulations, the Department of Fish and Game is committed to work with local, state, and federal regulatory agencies in the early stages of planning for areas under their jurisdiction. Early interaction between the Department and regulatory agencies should minimize possible problems in application of the guidelines.

APPENDIX E

ENERGY USE STUDY

ENVIRONMENTAL IMPACT REPORT ON WEST ANTIOCH CREEK IMPROVEMENTS IN CONTRA COSTA COUNTY DRAINAGE AREA 55 (PW 83-122)

I. INTRODUCTION

The proposed project will involve direct energy inputs in fuel use for construction, for long-term maintenance, and for materials, equipment, and personnel transportation to and from the site, during both construction and future maintenance. It will also involve indirect energy inputs in the production of fuel and materials, and their transportation to supplier distribution points.

In accordance with County energy-study practice, this analysis considers long-term project energy inputs for a 20-year period. However, unlike residential or commercial developments, the proposed project is essentially a one-time energy user, with most of the long-term input being required for construction and only a relatively minor portion being required for long-term operation, in the form of periodic maintenance. For both alternatives, it is estimated that about 93% of the project's long-term energy use will be in construction, and that only about 7% will be in maintenance, assuming no future problems requiring major repairs or reconstruction during the study period. (See page 8 for comparative summary of estimated project inputs and comparison of sample residential energy inputs.)

II. PURPOSE AND LIMITATIONS OF THE STUDY

The purpose of this study is to provide a brief energy-use analysis at a level adequate for environmental review, which will allow general comparison of estimated inputs for the two basic project alternatives: a concrete-lined channel and an earth channel.

At this point, the project plan is preliminary. No information is available regarding the construction details of the development alternatives, sources of construction materials, methods of construction, or the mix of construction and transportation equipment. However, the Flood Control section of the County Public Works Department has prepared construction-cost estimates and maintenance-cost estimates for both project alternatives. (See estimates beginning on page 16.) These estimates have been used as primary sources for estimating project energy input, subject to the following limitations:

A. No attempt has been made to estimate the various indirect energy inputs involving production of fuel or construction materials, or the transportation of these to supplier distribution points.

B. Because of lack of information, no attempt has been made to break-out all of the various individual, on-site construction procedures which would be involved in project development, in order to apply individual energy-inputs.

Instead, energy-input estimates for construction have been based on available fuel-use factors, applied to the general, major construction procedures--excavation/filling/compacting, concrete construction, and asphalt paving. Because of the need to generalize, it is assumed that minor construction procedures are accounted for in estimated energy-input for major procedures. For example, earthwork for culverts and sub-drains is assumed to be part of overall channel construction; and clearing and grubbing, dewatering, and removal of existing facilities are assumed to be part of channel excavation.

Thus, the analysis is focused on the major construction and materials-transportation requirements of the project alternatives which are listed on the cost estimates, or which are subject to reasonable assumptions.

III. STUDY METHODOLOGY

Based on the limitations discussed above, the basic energy-input analysis was prepared as follows:

A. Energy Input for Construction: Fuel use was derived from data in the County's energy-analysis guidelines*, based on the various construction processes listed in the County's preliminary cost estimates. (The fuel-use data in the guidelines are based on street and highway construction, but in lieu of specific information regarding the project's construction and mix of equipment, these data are assumed to be generally representative of proposed construction.)

B. Energy Input for Transportation of Materials: Fuel use is based on a set of assumptions regarding supplier locations for the various construction materials, the amounts of the required materials as specified in the preliminary cost estimates, and information obtained from various commercial sources regarding vehicle loads and fuel use. For each kind of material required, at least one commercial supplier was contacted, and information was obtained regarding sizes of truck loads, sources of supply nearest the project site, and any special requirements for supplying materials. This was not an exhaustive study, but was thorough enough to provide a general scenario for estimated fuel use based on the overall assumption that each contractor obtaining materials will use the local sources nearest the project site. (The individual assumptions and commercial references are contained in Section IV.)

C. Long-Term Energy Input in Project Maintenance: Fuel use is based on the County's cost estimates for annual maintenance

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* Interactive Resources, Inc.; May, 1976; Energy Conservation Guidelines for Evaluating New Development in Contra Costa County, California (Two volumes)

and a County estimate of the daily cost of a maintenance crew and equipment. The daily cost is divided into the annual cost to provide an estimate of annual days of maintenance, and fuel use is based on information provided by commercial sources and on assumptions about the travel distances required for maintenance operations.

IV. FUEL USE ASSUMPTIONS

A. Transportaion of Materials

1. Excavated Material: The usefulness of excavated materials for levee fill or structure backfill is not known. However, it is probable that a substantial portion of the material is not suitable for these purposes because of organic content. It is assumed that 75% of the material is useful and that 25% is not useful, and must be hauled off-site; and it is further assumed that the disposal site for the unusable material is the Antioch Dump on Somersville Rd., approximately three miles from the northerly end of the project site.

	Concrete Channel	Earth Channel
Total Excavation	105,000 cu. yd.	163,420 cu. yd.
75% usable	78,750	122,565
25% unusable	26,250	40,855
Total fill reqd.		
Structure backfill	19,000	
Structure backfill + levee		11,930
Remaining usable material excavated	59,750	110,635

It has been suggested that the excess, usable material could be used to fill in the vacant area near the site south and east of Sommersville Rd. and west of O St., consisting of around nine or 10 acres of undeveloped land. For this study, it is assumed that this is how the excess material will be used, and it is assumed that the average of total round trips for hauling the fill will be two miles/load.

2. Imported Construction Materials

a. Aggregate and Slope-Protection Rock

Assumed source: Kaiser Quarry, Clayton

Approx. round-trip miles: 20

b. Ready-Mix Concrete and Asphalt Concrete

Assumed source: Combination of various local suppliers in Antioch, Pittsburg, Concord, etc.

Approx. av. round-trip miles: 10

c. Reinforcing Steel

Assumed source: Klinger Steel, Union City

Approx. round-trip miles: 110

(Required reinforcing steel would total about 800-950 tons. It appears unlikely that local building supply sources would be able to accommodate an order this large. Therefore, it is assumed that a single, large supplier would receive the order. Klinger Steel was suggested by a local building supply firm as a logical choice. If this company were the source, the steel would be ordered from Cascade Rolling Mills in Oregon, and would be shipped by rail to Union City. Any required fabrication would be done by Klinger, and the materials would be shipped to the project site by truck.)

d. Reinforced Concrete Pipe

Assumed source: Ameron Pipe Products, Hayward

Approx. round-trip miles: 100

(Supplier suggested by local building materials firm, because of large pipe size. Ameron manufactures RCP.)

e. Steel Subdrain Pipe

Assumed source: Pacific Pipe, Oakland

Approx. round-trip miles: 90 (I-80/Hwy. 4)

(Supplier suggested by local building materials firm, because of large order.)

f. Chain Link Fencing

Assumed source: Sacramento wholesaler (direct shipment to site)

Approx. round-trip miles: 140

(Information from local fencing contractor.)

3. Truck Capacities

a. Aggregate and rock: 15 cu. yd. (5-axle bottom dump) (Plant manager; Royal Trucking, Concord. Capacity may vary with density of material.)

b. Ready-mix concrete: 7 cu. yd. (ready-mix truck)* (Plant manager; Antioch Building Materials)

c. Reinforcing Steel: 24 tons (Tractor/trailer) (Inger van Sickle; Klinger Steel, Union City)

d. Steel subdrain pipe: 2,372 ft. (tractor/trailer) (Milt Johnson; Kelly Pipe, Concord)

e. Chain link fencing: 2,000 ft. (tractor/trailer) (Alta Fence Co., Martinez)

f. Asphalt Concrete: 25 tons (end-dump transfer) (R. C. Tipton; Antioch Paving)

g. Reinforced Concrete Pipe: 16 ft. (tractor/trailer) (Ameron Pipe Products, Hayward)

4. Truck Milage

a. Five-axle bottom-dump: 4 mpg (varies 4-5 with age of equipment) (Plant Manager; Royal Trucking, Concord)

b. Ready-mix: 4 mpg (varies 4-5 with age of equip.) (Delta Ready-Mix, Pittsburg)

c. End-dump transfer: 7 mpg (R. C. Tipton; Antioch Paving)

d. Tractor/trailer: 5 mpg (varies with age of equip.) (various sources)

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* The process to be used for pouring concrete is not known. Because the proposed channel is wide, it may be possible, depending on the process, to use bottom-dumps for hauling and placing ready-mix for the concrete-lined channel alternative, or for a portion of the work.

B. Maintenance Equipment Fuel Use

1. Equipment and Fuel Consumption

The exact mix of equipment which would be needed for maintenance is not known. However, the following list of equipment is based on the assumption that no extraordinary maintenance (major repair, reconstruction) will be needed during the 20-year energy-input study period.

a. Pickup truck to transport crew, hand tools, and miscellaneous materials: Use 18 mpg

b. Backhoe: 10 gal./day
(Robert Martin Construction Co., Lafayette)

c. Ten-wheel flatbed truck to haul backhoe and operator: Use 10 mpg

d. Ten-wheel end-dump truck for miscellaneous hauling: Use 10 mpg

2. Maintenance Crew Travel

a. Concrete-lined channel: Assume that three-fourths of annual maintenance days are provided by County crews. (This is based on approximately three-fourths of the estimated annual maintenance cost being for the area north of Sommersville Rd., which is in the County.) Then, based on an estimate of $1,000/day for a maintenance crew and equipment and an estimate of $12,000/year for maintenance, there would be nine annual County maintenance days and three annual Antioch maintenance days.

For the County area of the project, which would require the most maintenance, assume that one day of maintenance requires all of the equipment listed under item 1, above. For the Antioch area, assume only a pickup and a ten-wheel end-dump truck. Then, assume the following approximate travel miles:

County crew: 36-mile round trip from Martinez to the project site for a pickup and two trucks, and 6-mile round trip from the site to the Antioch Dump for one truck (to dispose of clean up material).

Antioch crew: ½ mile round trip from the Antioch yard to the site for a pickup and one truck, and 6-mile round trip from the site to the Antioch Dump for one truck.

b. Earth channel: Assume that one-third of annual maintenance days are provided by County crews. (This is based on approximately one-third of the estimated annual maintenance cost being for the area north of Somersville Rd., which is in the County.) Then, based on an estimate of $1,000/day for a maintenance crew and equipment and an estimate of $30,000/year for maintenance, there would be 10 annual County maintenance days and 20 annual Antioch maintenance days.

Assume maintenance equipment mix and travel miles for both jurisdictions to be as described under item a., above.

3. Future Jurisdictional Responsibilities for Maintenance

It is anticipated that the City of Antioch will eventually annex the portion of the project which is in the County. The timing of such an annexation can not be accurately predicted. However, for purposes of this study, it is assumed that the annexation will occur in ten years. At that time, the City will be responsible for maintenance of the entire project, and fuel use for maintenance will change accordingly for the last ten years of the of the 20-year energy-input analysis.

C. Fuel Use for Project Construction

It is assumed that estimated energy inputs for actual on-site construction will be in accordance with the fuel-use factors listed in the County's energy-analysis guidelines (cited previously) for various, general construction processes. (The various factors are cited in Section VI, Energy Input Calculations. Section V, on the following page, summarizes the calculations from Section VI.)

SUMMARY OF ESTIMATED, DIRECT ENERGY INPUTS FOR ALTERNATIVE IMPROVEMENTS OF WEST ANTIOCH CREEK, DRAINAGE AREA 55 (PW 83-122)*

	Concrete-Lined Channel		Earth Channel	
	BTU x 100,000 (therms)**	% of Total	BTU x 100,000 (therms)	% of Total
INITIAL ENERGY INPUTS				
Transportation of Excavated Materials	6,369	10.2	10,726	14.5
Transportation of Construction Materials	14,768	24.0	7,803	10.8
Construction	36,428	59.2	48,512	66.9
ENERGY INPUTS FOR LONG-TERM MAINTENANCS (20 Years)	3,926	6.4	5,493	7.5
TOTAL 20-YEAR DIRECT ENERGY INPUTS ESTIMATE	61,491	100.0	72,534	100.0
ESTIMATED ENERGY INPUT IN BARRELS OF OIL***	1,060		1,250	

* Not including direct inputs for manufacture of materials or fuel, or transportation of materials or fuel to supplier distribution points.

** One therm = 100,000 BTU. A BTU (British Thermal Unit) is the amount of heat needed to raise the temperature of one pound of water by one degree F.

*** One barrel of oil = 5,800,000 BTU.

SAMPLE, ESTIMATED ENERGY INPUTS PREVIOUSLY CALCULATED FOR PROPOSED RESIDENTIAL DEVELOPMENTS - FOR COMPARISON WITH ESTIMATED ENERGY INPUT FOR THE PROPOSED PROJECT*

	Initial Construction (therms)	Long-Term Inputs (therms)	20-Year Total (therms)	20-Year Total (barrels)
19 detached units, PUD, hillside development, Shepherd Canyon, Oakland	250,384	1,433,553	1,683,937	29,033
10 units, hillside PUD, Skyline Blvd., Oakland	145,028	758,300	903,408	15,576
200-unit PUD, attached + detached, with recreation facilities and sewer treatment plant, Port Costa/Crockett area	3,019,575	27,597,184	30,616,759	527,875

* These estimates include indirect energy inputs for production of materials and fuel. However, as can be seen by comparing them with the estimated inputs for the project, even if the project estimates were doubled to account for indirect inputs, the estimated energy use for the project would be substantially less than the two smallest residential developments. For residential developments, energy-use calculations typically indicate that long-term inputs (household gas and electricity, facilities maintenance, and travel to and from the site) will amount to 80-90% of 20-year energy use, and initial construction will amount to 10-20%.

VI. CALCULATIONS OF ESTIMATED ENERGY INPUTS

A. CONCRETE-LINED CHANNEL

1. Transportation of Excavated Material

a. 25% unusable material to Antioch Dump:

26,250 cu. yd. at 15 cu. yd./load* = 1,750 loads x 6 mi./load = 10,500 mi. at 4 mpg = 2,625 gals. x 1.38 therms/gal. = 3,623 therms**

b. Usable fill, not used on the site, to off-site vacant property near project:

78,750 cu. yd. usable less 19,000 cu. yd. used on-site for backfill = 59,750 cu. yd. at 15 cu. yd./load = 3,983 loads x 2 mi./load = 7,966 mi. at 4 mpg = 1,992 gals. x 1.38 therms/gal. = 2,746 therms

2. Transportation of Materials to the Site

a. Aggregate: 12,000 cu. yd. at 15 cu. yd./load = 750 loads x 20 mi./load = 15,000 mi. at 4 mpg = 3,750 gals. x 1.38 therms/gal. = 5,175 therms

b. Concrete: 15,255 cu. yd. at 7 cu. yd./load = 2,179 loads x 10 mi. av./load = 21,790 mi. at 4 mpg = 5,448 gals. x 1.38 therms/gal. = 7,518 therms

c. Asphalt Concrete: 700 tons at 25 tons/load = 28 loads x 10 mi. av./load = 280 mi. at 7 mpg = 40 gals. x 1.38 therms/gal. = 55 therms

d. Reinforcing Steel: 951 tons at 24 tons/load = 40 loads x 110 mi./load = 4,400 mi. at 5 mpg = 880 gals. x 1.38 therms/gal. = 1,214 therms

---

* Five-axle bottom-dump trucks can haul 15 to 22 cubic yards of material, depending on the composition and weight. For this analysis 15 "bank" yards/load are assumed. Bank material is directly excavated material, which is heavier than loose dirt. Also, it is assumed that a portion of the excavated material will be damp.

** The direct energy value of one gallon of diesel fuel is 138,095 BTUs. One therm = 100,000 BTU. A BTU (British Thermal Unit) is the amount of heat required to raise the temperature of one pound of water by one degree F.

e. 96-Inch Reinforced Concrete Pipe: 312 lin. ft. at 16 ft./load = 20 loads x 100 mi./load = 2,000 mi. at 5 mpg = 400 gals. x 1.38 therms/gal. = 552 therms

f. Steel Subdrain Pipe: 9,890 lin. ft. at 2,372 ft./load = 4 loads x 90 mi./load = 360 mi. at 5 mpg = 72 gals. x 1.38 therms/gal. = 99 therms

g. Chain Link Fencing: 8,846 lin. ft. at 2,000 ft./load = 4 loads x 140 mi./load = 560 mi. at 5 mpg = 112 gals. x 1.38 therms/gal. = 155 therms

3. Construction

a. Excavating, Hauling, and Compacting: This includes channel excavation, construction of levees and structure backfills, and placement and compaction of a portion of the excavated material on property near the project site, as discussed previously.

Assume a fuel-use factor of 0.20 gallons/cu. yd. of material (Table A-18, County energy conservation study, for highway construction work, on a major, balanced project, in non-rocky soil).

0.20 gal./cu. yd. x 105,000 cu. yd. = 21,000 gals. x 1.38 therms/gal. = 28,980 therms

b. Asphalt Paving: Assume 1.5 days with crew and roller for 700 tons AC paving, and 70 gallons/day fuel use for roller (R. C. Tipton, Antioch Paving).

1.5 days x 70 gals./day = 105 gals. x 1.26 therms/gal. = 132 therms

c. Construction of Concrete Channel: Assume a fuel-use factor of 0.30 gal./cu. yd. for mix of all equipment and various tasks (Table A-18, County energy conservation study).

0.30 gal./cu. yd. x 15,255 cu. yd. = 4,577 gals. x 1.38 therms/gal. = 6,316 therms

4. 20-Year Energy Input for Maintenance

a. First 10 Years: County and City of Antioch share maintenance prior to Antioch annexation of total project area.

i. County:

Pickup truck: 36 mi. at 18 mpg = 2 gals. gas* x 1.26 therms/gal. = 2.25 therms

10-wheel flatbed: 36 mi. at 10 mpg = 3.6 gals. x 1.26 therms = 4.5 therms

10-wheel end-dump: 36 mi. + 6 mi. = 42 mi. at 10 mpg = 4.2 gal. x 1.26 therms/gal. = 5.29 therms

Backhoe: 10 gals./day x 1.26 therms/gal. = 12.6 therms

Total: 25 therms/day x 9 maintenance days/ year = 225 therms/ year x 10 yrs. = 2,250 therms

ii. Antioch:

Pickup truck: 0.5 mi. at 18 mpg = 0.26 gal. x 1.26 therms/gal. = 0.33 therms

10-wheel end-dump: 0.5 mi. + 6 mi. = 6.5 mi. at 10 mpg = 0.65 gal. x 1.26 therms/gal. = 0.82 therms

Total: 1.15 therms/day x 3 maintenance days/year = 3.45 therms/yr. x 10 yrs. = 34.5 therms

iii. County + Antioch:

34.5 therms + 2,250 therms = 2,285 therms/ 10 yrs.

b. Second 10 Years: Antioch maintenance only, assuming annexation of total project area.

Pickup truck: 0.33 therms/day x 12 maintenance days/yr. = 3.96 therms/yr. x 10 yrs. = 39.6 therms/10 yrs.

10-wheel end-dump: 0.82 therms/day x 12 maintenance days/yr. = 8.2 therms/yr. x 10 yrs. = 82 therms/10 yrs.

10-wheel flatbed: 0.5 mi. at 10 mpg = 0.05 gal. x 1.26 therms/gal. = 0.065 therms/day x 12 maintenance days/yr. = 0.756 therms/yr. x 10 yrs. = 7.56 therms/10 yrs.

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* The direct energy value of gasoline is 1.26 therms/gallon or 126,190 BTU.

Backhoe: 12.6 therms/day x 12 maintenance days/yr. = 151.2 therms/yr. x 10 yrs. = 1,512 therms/10 yrs.

Total: 39.6 + 82 + 7.56 + 1,512 = 1,641 therms/10yrs.

c. Total Estimated 20-Year Input:

County	2,250 therms
Antioch	1,676
Total	3,926 therms

B. EARTH CHANNEL

1. Transportation of Excavated Material

a. 25% unusable material to Antioch Dump:

40,855 cu. yd. at 15 cu. yd./load = 2,723 loads x 6 mi./load = 16,338 mi. at 4 mpg = 4,085 gals. x 1.38 therms/gal. = 5,637 therms

b. Unusable fill, not used on the site, to off-site vacant property near project:

122,565 cu. yd. usable less 11,930 cu. yd. used on-site for levees and fill = 110,635 cu. yd. at 15 cu. yd./load = 7,376 loads x 2 mi. = 14,752 mi. at 4 mpg = 3,688 gals. x 1.38 therms/gal. = 5,089 therms

2. Transportation of Materials to the Site

a. Aggregate and Slope-Protection Rock: 4,670 cu. yd. at 15 cu. yd./load = 311 loads x 20 mi./load = 6,220 mi. at 4 mpg = 1,555 gals. x 1.38 therms/gal. = 2,146 therms

b. Concrete: 7,810 cu. yd. at 7 cu. yd./load = 1,115 loads x 10 mi. av./load = 11,150 mi. at 4 mpg = 2,788 gals. x 1.38 therms/gal. = 3,847 therms

c. Asphalt Concrete: 1,000 tons at 25 tons/load = 40 loads x 10 mi. av./load = 400 mi. at 7 mpg = 57 gal. x 1.38 therms/gal. = 79 therms

d. Reinforcing Steel: 807 tons at 24 tons/load = 34 loads at 110 mi./load = 3,740 mi. at 5 mpg = 748 gals. x 1.38 therms/gal. = 1,032 therms

e. 96-Inch Reinforced Concrete Pipe: 360 lin. ft. at 16 ft./load = 23 loads x 100 mi./load = 2,300 mi. at 5 mpg = 460 gals. x 1.38 therms/gal. = 635 therms

f. Steel Subdrain Pipe: 2,530 lin. ft. at 2,372 ft./load = 1 load x 90 mi./load = 90 mi. at 5 mpg = 18 gals. x 1.38 therms/gal. = 25 therms

g. Chain Link Fencing: 2,050 lin. ft. at 2,000 ft./load = 1 load x 140 mi./load = 140 mi. at 5 mpg = 28 gals. x 1.38 therms/gal. = 39 therms

3. Construction

a. Excavation, Hauling, and Compacting: This includes channel excavation, construction of levees and structure backfills, and placement and compaction of a portion of the excavated material on property near the project site, as discussed previously.

Assume a fuel-use factor of 0.20 gallons/cu. yd. of material (Table A-18, County energy conservation study, for highway construction work, on a major, balanced project, in non-rocky soil).

0.20 gal./cu. yd. x 163,420 cu. yd. = 32,684 gals. x 1.38 therms/gal. = 45,103 therms

b. Asphalt Paving: Assume 2 days with crew and roller for 1,000 tons AC paving, and 70 gallons/day fuel use for roller (R. C. Tipton, Antioch Paving).

2 days x 70 gals./day = 140 gals. x 1.26 therms/gal. = 176 therms

c. Concrete Construction: Assume a fuel-use factor of 0.30 gal./cu. yd. for mix of all equipment and various tasks (Table A-18, County energy conservation study).

0.30 gal./cu. yd. x 7,810 cu. yd. = 2,343 gals. x 1.38 therms/gal. = 3,233 therms

4. 20-Year Energy Input for Maintenance

a. First 10 Years: County and City of Antioch share maintenance prior to Antioch annexation of total project area.

i. County:

Pickup truck: 2.52 therms/day

10-wheel flatbed: 4.5 therms/day

10-wheel end-dump: 5.29 therms/day

Backhoe: 12.6 therms/day

Total: 25 therms/day x 10 maintenance days/yr. = 250 therms/yr. x 10 yrs. = 2,500 therms/10 yrs.

ii. Antioch:

Pickup truck: 0.33 therms/day

10-wheel end-dump: 0.82 therms/day

Total: 1.15 therms/day x 20 maintenance days/yr. = 23 therms/yr. x 10 yrs. = 230 therms/10 yrs.

iii. County + Antioch:

2,500 therms + 230 therms = 2,730 therms/ 10 yrs.

b. Second 10 Years: Antioch maintenance only, assuming annexation of total project area.

Pickup truck: 0.33 therms/day x 20 maintenance days/yr. = 6.6 therms/yr. x 10 yrs. = 66 therms/10 yrs.

10-wheel end-dump: 0.82 therms/day x 20 maintenance days/yr. = 16.4 therms/yr. x 10 yrs. = 164 therms/10 yrs.

10-wheel flatbed: 0.063 therms/day x 20 maintenance days/yr. = 1.26 therms/yr. x 10 yrs. = 12.6 therms/10 yrs.

Backhoe: 12.6 therms/day x 20 maintenance days/yr. = 252 therms/yr. x 10 yrs. = 2,520 therms/10 yrs.

Total: 66 + 164 + 12.6 + 2,520 = 2,763 therms/10 yrs.

c. Total Estimated 20-Year Input:

County	2,500 therms
Antioch	2,993
Total	5,493 therms

CONTRA COSTA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
COST ESTIMATE

PRELIMINARY

PROJECT NAME West Antioch Creek PROJECT NO.

DESCRIPTION _____ ALTERNATE 2

COMP. IAH DATE 3/12/94 CHKD. _____ DATE _____ APPROVED _____ DATE _____

BUDGET ☐ PRELIMINARY ☒ FINAL ☐

(A) CONSTRUCTION COST

Item	Unit	Quantity	Unit Price	Total
1. Mobilization	LS	—	—	25,000
2. Remove Exist. Facilities	LS	—	—	25 000
3. Clearing & Grubbing	LS	—	—	10,000
4. Dewatering	LS	—	—	5,000
5. Channel Excavation	CY	163420	5.00	817,100
6. Levee Fill	CY	8140	15.00	122,100
7. Structure Backfill	CY	3790	20.00	75800
8. Pervious Material	CY	2870	25.00	71,750
9. Erosion Control	SF	240,000	0.10	24,000
10. Asphalt Concrete	Ton	1000	45.00	45,000
11. Class A Concrete (Channel)	CY	2200	175.00	385,000
12. Class A Concrete (RCB)	CY	4,110	225.00	924750
13. Class A Concrete (Miscellaneous)	CY	1500	250.00	375,000
14. Reinforcement	LBS	1614,400	0.55	887,920
15. 96" RCP (reduced section)	LF	360	550.00	198,000
16. 6' Steel Subdrains w/cloth	LF	2530	6.00	15,180
17. Rock Slope Protection (1/4 ton)	CY	1800	45.00	81,000
18. 6' CL and Safety Fencing	LF	2050	15.00	30750
19.				
20.				
TOTAL CONSTRUCTION COST				4,118,350

PRELIMINARY COST ESTIMATE - Earth Channel

CONTRA COSTA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
COST ESTIMATE

PROJECT NAME West Antioch Creek PROJECT NO. _____

DESCRIPTION _____ ALTERNATE 1

COMP. LLK DATE 2/27/14 CHKD. _____ DATE _____ APPROVED _____ DATE _____

BUDGET ☐ PRELIMINARY ☒ FINAL ☐

PRELIMINARY

(A) CONSTRUCTION COST

Item	Unit	Quantity	Unit Price	Total
1. Mobilization	LS	—	—	25,000
2. Remove Existing Facilities	LS	—	—	25,000
3. Clearing & Grubbing	LS	—	—	7,000
4. Dewatering	LS	—	—	5,000
5. Channel Excavation	CY	125,000	6.00	625,000
6. Structure Backfill	CY	19,000	20.00	380,000
7. Pervious Material	CY	12,000	25.00	300,000
8. Erosion Control	LS	—	—	2,000
9. Asphalt Concrete	Ton	700	45.00	31,500
10. Class A Concrete, Channel & Other	CY	12,315	175.00	2,155,125
11. Class A Concrete, RCP	CY	2,940	225.00	661,500
12. Reinforcement	LBS	1,901,540	0.50	950,770
13. 96" RCP Culvert X-ing	LF	212	550	171,600
14. 6" Steel Subsurface Drain w/cloth	LF	9890	6.00	59,340
15. 6' CL Safety Fencing	LF	8846	15.00	132,690
16.				
17.				
18.				
19.				
20.				
TOTAL CONSTRUCTION COST				5,432,525
			≈ ±	5,430,000

PRELIMINARY COST ESTIMATE - Concrete-Lined Channel

4. MAINTENANCE OF IMPROVEMENTS

Maintenance activities would consist of removing sediments from the outlet pond and stilling basin and trimming excessive vegetative growth in those areas; removing sediments and trash from the channel upstream of the stilling basin, doing concrete repair work and repairing safety railing and fencing.

Alternate 2 would require additional work, consisting of earth and rock channel repair, removing excessive vegetative growth from the channel bottom and sides and doing landscape repair and maintenance.

The costs of this are estimated at shown:

Alternate 1:

Location	Type of Work	Cost
Outlet Pond and Stilling Basin	Sediment removal and veg. trimming	$8,000
Stilling Basin to Somersville Road	Concrete and fence repair, sediment removal	$1,500
Somersville Road to End of Project	Concrete and fence repair, trash removal	$2,500
	Total annual maintenance cost:	$12,000

Alternate 2:

Outlet Pond and Stilling Basin	Sediment removal and veg. trimming	$8,000
Stilling Basin to Somersville Road	Concrete and fence repair sediment removal	$1,500
Somersville Road to End of Project	Concrete and fence repair	$500
	Trash and sediment removal	$5,000
	Channel repair	$10,000
	Vegetation control	$2,500
	Landscape maintenance	$2,500
	Total annual maintenance cost:	$30,000

The annual maintenance costs have not been made part of the cost estimate for Alternates 1 and 2.

CALIFORNIA ENVIRONMENTAL QUALITY ACT

NOTICE OF

☒ Completion of Environmental Impact Report

☐ Negative Declaration of Environmental Significance

CONTRA COSTA COUNTY PLANNING DEPARTMENT
P.O. Box 951 Martinez, California 94553

Telephone: (415) 372-4470 Contact Person Steve Wright

Project Description and Location: PW 83-122: West Antioch Creek Improvements:

The proposed project lies west of "O" Street, between the marsh area north of the A.T. & S.F. Railroad and the south side of the S.P.T. Co. Railroad.

The project consists of creek channelization, installation of rectangular concrete channels, box culverts, a stilling/sedimentation basin, an outlet pond and miscellaneous storm drainage improvements.

☐ Justification for Negative Declaration is attached.

☒ The Environmental Impact Report is available for review at the address below:

Contra Costa County Planning Department
4th Floor, North Wing, Administration Building
Pine & Escobar Streets
Martinez, California

Review Period for Environmental Impact Report or Negative Declaration: Sept. 4, 1984
thru Oct. 19, 1984

By Dennis M. Barry
Planning Department Representative

AP 9 R3/79

Army Corps of Engineers Reconnaissance Report

RECONNAISSANCE REPORT
WEST ANTIOCH CREEK INVESTIGATION
CALIFORNIA

August 1988

Department of the Army
Sacramento District, Corps of Engineers
Sacramento, California

WEST ANTIOCH CREEK INVESTIGATION
CALIFORNIA
RECONNAISSANCE REPORT

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Chapter IV - Technical Studies

Chapter V - Alternative Plans

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APPENDIX

CHAPTER I - INTRODUCTION

STUDY AUTHORITY

This study was initiated in April 1987 under the authority of Section 205 of the 1948 Flood Control Act, as amended (33 USC 701s).

PURPOSE AND SCOPE

The purposes of this reconnaissance study are to evaluate the potential feasibility of providing additional flood control along West Antioch Creek and to determine whether there appears to be a Federal interest in participating in at least one flood control plan.

The scope has generally been limited to an evaluation of the channel improvement plan developed by the Contra Costa County Flood Control and Water Conservation District (CCCFCWCD). The level of detail used for this reconnaissance study is that necessary to determine if further detailed studies are warranted.

PRIOR STUDIES AND REPORTS

1. Corps of Engineers

There have been no prior studies or reports by the Corps of Engineers in the study area.

2. Federal Emergency Management Agency (FEMA)

"Flood Insurance Study, City of Antioch, California, Contra Costa County," December 1980 (rev. September 1987).

"Flood Insurance Study, Contra Costa County, California, Unincorporated Areas," July 1987.

The purpose of these Flood Insurance Studies was to investigate the existence and severity of the flood hazard in the study area and to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. The studies develop flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the communities in their efforts to promote sound flood plain management.

3. Contra Costa County Flood Control and Water Conservation District

"Engineer's Report for Improvements on Lower West Antioch Creek, Contra Costa County Service Area D-3," June 1984. The purpose of this study was to identify flood problems and

opportunities on lower West Antioch Creek. Analysis of the alternatives included hydrologic studies; engineering designs; and construction, operation and maintenance cost estimates.

4. Contra Costa County Planning Department

"Draft Environmental Impact Report for West Antioch Creek Improvements," June 1984. This report evaluated environmental impacts of the channel improvement alternatives proposed by CCCFCWCD as required for a focused Draft Environmental Impact Report (EIR) under the California Environmental Quality Act. This draft EIR considered both biological and sociological effects, included a cultural resources survey, and proposed mitigation efforts.

Results of these studies were used extensively in preliminary Corps analyses. Background information and technical data and design information were incorporated into the reconnaissance phase of the study.

EXISTING AND PROPOSED PROJECTS

Existing projects located in the West Antioch Creek watershed are discussed below.

1. Corps of Engineers

There are no other existing or proposed Corps of Engineers projects in the study area.

2. Bureau of Reclamation (Bureau)

Two components of the Bureau's Central Valley Project are located in the study area. The Contra Loma Reservoir is located in the southern portion of the watershed and has a gross capacity of about 2,100 acre-feet (A.F.). The Contra Costa Canal crosses the watershed from east to west, north of the Contra Loma Reservoir. Completed in 1940, the canal can convey 350 cubic feet per second (cfs) of water for irrigation, municipal and industrial uses, water quality and recreation.

3. East Bay Municipal Utility District

The Mokelumne Aqueduct transfers water from the Camanche and Pardee Reservoirs to the San Francisco area and crosses the West Antioch Creek basin in a northwesterly direction.

4. City of Antioch

The Antioch Municipal Reservoir is located east of the Contra Loma Reservoir and stores Contra Costa Canal water for the City of Antioch. The gross capacity of the reservoir is about 770 A.F.

CHAPTER II - STUDY AREA

LOCATION

The West Antioch Creek watershed is located near the City of Antioch, Contra Costa County, in north central California (see Figure 1). The approximately 12-square-mile basin extends from the San Joaquin River southward to the ridges near the end of Sommersville Road. The study area is located in the northern section of the watershed and extends from the San Joaquin River to Putnam Street.

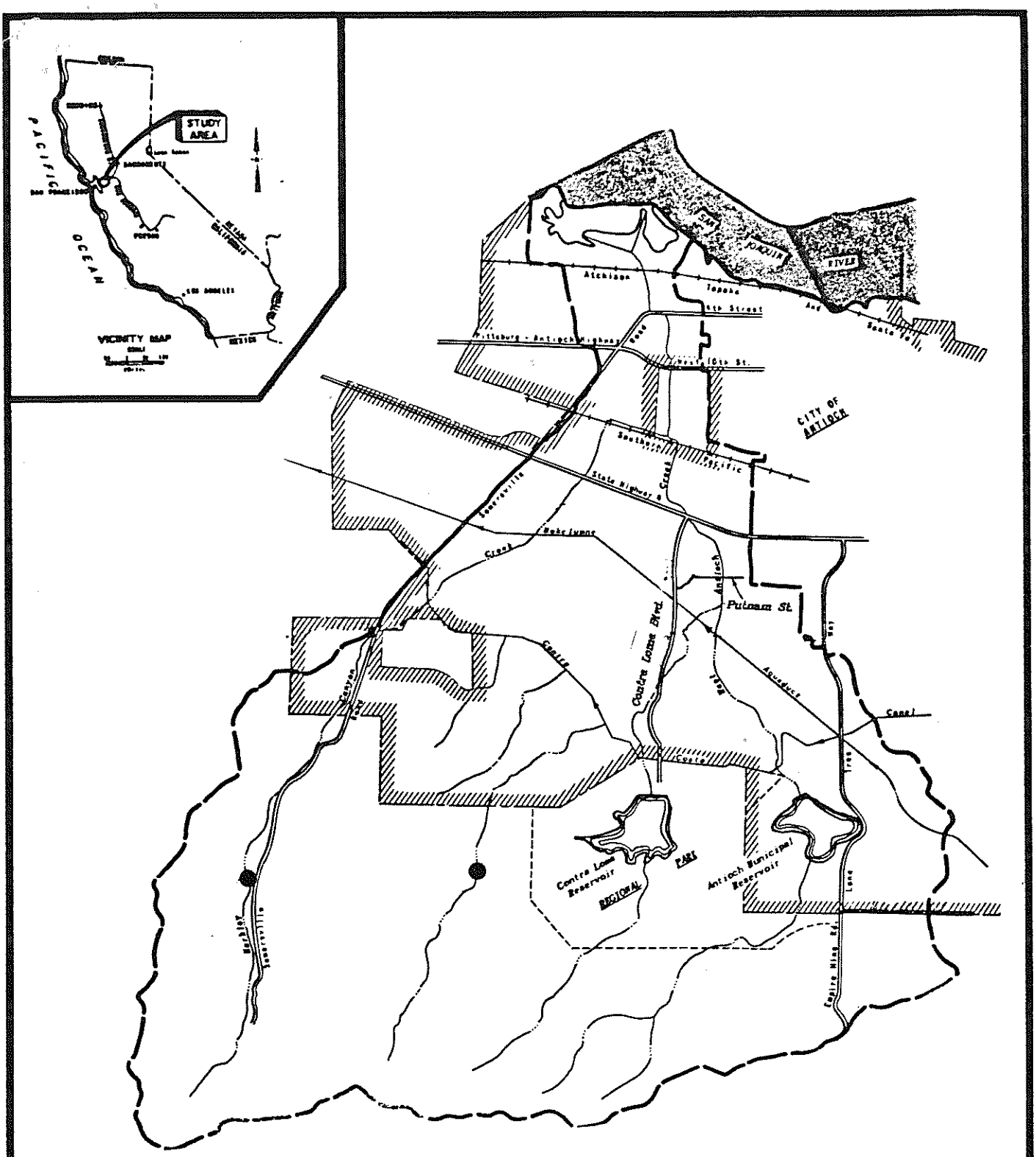
NATURAL RESOURCES

1. Basin Description

The West Antioch Creek watershed extends from near mean sea level (msl) at the tidal marshes to about 1,500 feet msl at the headwaters. Major tributaries, generally classified as intermittent streams, originate in the mountainous terrain of the southern portion of the basin. These narrow, steep-sided ravines and canyons are dominated by well-drained clayey soils on soft shales.

The streams flow in a northerly direction over a relatively flat alluvial plain composed of predominantly excessively drained sandy soils. This lower drainage system passes through the City of Antioch and its sphere of influence, where it is heavily abutted by residential, commercial and industrial development. Historically, West Antioch Creek and its tributaries were classified as intermittent; however, because of increased drainage from summer irrigation in the lower watershed, lower West Antioch Creek maintains minor flows all year and is considered perennial north of Highway 4. West Antioch Creek eventually drains into a brackish marsh area adjacent to the San Joaquin River.

Within the study area, West Antioch Creek is characterized by straightened channels, nearly 90-degree bends and sections of concrete channel. Much of the existing stream has been altered to accommodate development. Some sections have been improved as required for the newer subdivision developments, including West Antioch Creek between State Highway 4 and the Southern Pacific Railroad (SPRR) (about 2,500 feet) and from about 1,000 feet upstream to 1,000 feet downstream of Putnam Street (about 2,000 feet). A small section of concrete-lined channel also exists on West Antioch Creek, northward from 10th Street about 650 feet. The remainder of West Antioch Creek is an earth ditch with a bottom width of 6 to 10 feet and banks that are about 5 to 8 feet high. Channel side slopes are typically between 1:1 and 1:2 (vertical to horizontal).



LEGEND

- Drainage Boundary
- Railroad
- Reservoir
- Antioch Corp Bdy.
- Regional Park Bdy.
- Canal or Aqueduct
- Detention Basin Site

WEST ANTIOCH CREEK STUDY, CALIFORNIA

BASIN MAP

Sacramento District, Corps of Engineers
July 1988

FIGURE 1

00241

2. Climate

The climate is characterized by abundant sunshine in summer, moderate to heavy rainfall in late fall and winter, and temperatures ranging from about 40 degrees Fahrenheit in January to about 75 degrees Fahrenheit in September. Major storms occur during the period of October through April, when over 90 percent of all rainfall occurs. Normal annual precipitation for the West Antioch Creek basin ranges from 12.5 inches at the San Joaquin River to about 18.0 inches at the headwaters.

3. Vegetation

Vegetation in the basin consists chiefly of annual grasses with limited areas of riparian vegetation along the creeks. Upper reaches of West Antioch Creek are generally lacking in riparian vegetation, other than rushes and sedges. Thickets of willow occur in the marshy area north and south of the Atchinson, Topeka & Sante Fe Railroad (AT&SF RR), and several large trees grow within 200 feet of the west bank of the creek downstream of Somersville Road. The marsh area, which is subject to tidal action, is composed of both fresh and saltwater species.

4. Fish and Wildlife

Due to development in the lower basin, the streams and adjacent vegetation constitute one of the remaining areas for fish and wildlife habitat. However, due to development adjacent to the creek, West Antioch Creek supports only a meager fish population consisting primarily of mosquito fish. As part of the Sacramento-San Joaquin Delta system, the brackish marsh downstream of the AT&SF RR supports various anadromous and warmwater game and nongame fish.

The open upland habitat in the basin supports ground squirrels, jackrabbits, a few small rodents and several bird species. The stream reaches provide limited riparian habitat and serve as movement corridors through the urban areas. Riparian vegetation along the lower reaches of West Antioch Creek provides food and cover to small animals. The brackish marsh adjacent to the San Joaquin River provides habitat for a variety of wildlife, including migratory and resident birds, waterfowl, muskrat, skunk, raccoon, and small rodents.

5. Endangered Species

The Endangered Species Office of the U.S. Fish and Wildlife Service has identified the Federally-listed endangered salt marsh harvest mouse and nine candidate species as possibly occurring in the study area, primarily in the brackish marsh downstream of the AT&SF RR. Additional studies would be necessary to determine if listed or proposed species are present and whether suitable habitat exists in the area.

DEVELOPMENT AND ECONOMY

1. Population

The mouth of West Antioch Creek is approximately 2,000 feet west of the historic town center of Antioch. The City was incorporated in 1872 and is the oldest incorporated city in Contra Costa County. The City's population has increased about 12 percent since 1980. Other demographic data is shown in Table 1.

Table 1
Demographic Characteristics
City of Antioch

	1980	1986
Total Population	42,683	47,233
Median Household Income	$20,892	$28,306
Total Households	14,955	16,723
Average Home Value	$92,000	$120,000

Currently, many Antioch residents work outside of the area, but employment opportunities exist in industry, retail and services within the city limits.

2. Land Use

Existing land use in the watershed includes agricultural, industrial, commercial and residential. Development in the flat northern area is mainly industrial and commercial. The mid-watershed area has experienced nearly continuous growth in residential and commercial (retail sales and service) development during the past 20 years. Consequently, some sections of West Antioch Creek have been improved as required for the newer subdivision developments. Development in the entire basin is expected to be nearly complete by 1990.

The southern portion of the watershed is mainly agricultural, open space and parklands. Permanent open space within the West Antioch Creek watershed includes the Black Diamond Mines and Contra Loma Regional Preserves, along with the Antioch Municipal Golf Course. It is anticipated that the steep portions of the southern watershed will remain in open space for the foreseeable future.

CHAPTER III - PROBLEMS AND OPPORTUNITES

FLOODING

Portions of the City of Antioch frequently experience shallow flooding as fall and winter rainfall storms move over the area. Existing channels overflow and flood adjacent lands when streamflows exceed those of a 2- to 5-year event. In addition to inadequate channel capacity, the creek flows under railroads and roads via culverts and bridges that are unable to pass peak flood flows.

Damages due to flooding along West Antioch Creek in January 1982 included property damage, damage to manufactured products and lost production time. A 1983 storm caused flood damages at the County Fairgrounds, an auto dealership, a motel/restaurant, several apartments and businesses on "O" Street, the City Maintenance Services Center, and a glass container manufacturing facility. In addition, traffic in the northwest area of the City of Antioch was paralyzed due to road closures. During this 1983 flood, about 20 businesses were flooded.

Local agencies have expressed the need to reduce these flooding problems that exist along West Antioch Creek.

SEDIMENTATION

Sediment recruitment and transport pose environmental and hydraulic concerns in the West Antioch Creek basin. Hydraulically, sediment reduces the conveyance of the stream channels. Removal of excess sediment increases the cost of channel maintenance and may require costly sediment control measures. Environmentally, the deposition of sediment in the stream channels and the marsh area downstream of the AT&SF RR could impact the fish and wildlife habitat in those areas. Concerns in formulating a flood control plan focus on two issues. First, is the sediment yield of the basin increased as a result of the plan? Second, are the areas of sediment deposition ("sinks") and the amount of deposition in these sinks changed as a result of the plan, and, if so, does this impact the functioning of the plan or adversely impact the environment?

Currently, the City of Antioch keeps the channel free of excess sediment deposits that could reduce the conveyance of the channel.

CHAPTER IV - TECHNICAL STUDIES

HYDROLOGY

The hydrologic analysis of the West Antioch Creek basin included: collecting and analyzing precipitation data, determining hydrologic characteristics of the basin, and developing a mathematical computer model to simulate the rainfall/runoff response of the basin. The computer program used in this analysis was the HEC-1, Flood Hydrograph Package, January 1985. The computer model was used to simulate various frequency flood events for both existing and future land use conditions. Much of the data generated by the CCCFCWCD in their hydrologic analysis was used to develop the parameters for this model. Also, the effects of the existing water resource projects described in "Existing and Proposed Projects" (Chapter I) were incorporated into the hydrologic analysis.

1. Storm Analysis

There are several recording precipitation gages located in the vicinity of the basin. Precipitation data from these stations provided the basis for developing the basin precipitation and time distribution of rainfall. This analysis is discussed in Section 4, Flow Frequency Analysis.

2. Streamflow Analysis

There are no streamflow recording stations located on West Antioch Creek or its tributaries.

3. Flood Analysis

The flood analysis included developing the following hydrologic parameters: base flows, loss rates, unit hydrographs, and flood routing parameters. The development of these parameters was based on the physical characteristics of the basin. The analysis was facilitated by subdividing the West Antioch Creek basin at points of channel constriction and/or confluences.

A base flow rate of 5 cubic feet per second per square mile (csm) was used in this analysis.

The modified Los Angeles District S-curve procedure was used to compute unit hydrographs. This procedure utilizes a non-dimensional summation graph (S-graph) in conjunction with a basin factor (n), which relates lag time to basin characteristics.

00245

Modified puls and Muskingum routing methods were used for the routing of flood hydrographs on West Antioch Creek and its tributaries. Modified puls routings are based on storage/discharge relationships developed from HEC-2 Water Surface Profiles computer runs. Muskingum routing was used where modified puls routing data were unavailable. Muskingum routing is based on average flow velocities and travel times.

An average constant loss rate of 0.18 inch per hour and an initial loss of 0.25 inch were adopted for calculating the standard project and 100-year floods. The average loss rate for each subarea varies with the percent of impervious area. The percent of imperviousness for each land use category is shown in Table 2.

Table 2
Land Use and Percent Imperviousness

Land Use	Percent Imperviousness
Agriculture	5
Recreation	10
Low Density Urban	25
High Density Urban	35
Schools	15
Commercial & Utilities	60
Industrial	90

Loss rates were developed for both present land use conditions (Year 1990) and estimated future land use conditions (Year 2040). The effects of land use changes on runoff were accounted for by lowering loss rates in proportion to the imperviousness of each subarea.

Future urban development will probably occur in the upper basin, while commercial and industrial expansion will be located in or near the City of Antioch. Present land uses were estimated from available U.S. Geological Survey topographic maps and recent urban development plans by the City. Future land use was estimated based on projections by the City.

4. Flow Frequency Analysis

Standard project and more frequent floods were computed for the West Antioch Creek basin by using the HEC-1 "Flood Hydrograph Package" rainfall-runoff method. Both the hypothetical general rain (24-hour) and cloudburst (3-hour) events were developed to determine the most critical runoff peak flows.

00246

Rainfall frequency curves for various durations were developed from NOAA Atlas No. 2, Volume XI, California, 1973. Rainfall amounts for each subarea were computed by multiplying the point rainfall amounts by the ratio of each subarea normal annual precipitation (NAP) to the total area NAP. The 96-hour percent distribution for 1 to 100 square miles and for elevations of less than 2,000 feet was used to determine the maximum Standard Project Storm percent distribution.

Peak flows for various frequency flood events were computed using the corresponding rainfall amounts and the previously described hydrologic parameters as input to the basin computer model.

Results of this analysis indicated that the cloudburst storms produce the more critical runoff condition. In addition, because most development in the basin will occur prior to 1990, peak flow frequencies differ very little from present land use conditions to future land use conditions. Flow frequency curves are shown on Figure 2.

ENGINEERING DESIGN

The purpose of this section is to describe the design criteria and procedures used in the analysis of channel improvements along lower West Antioch Creek. The HEC-2, Water Surface Profiles computer package, was used to model channel improvements. Stream reaches evaluated are shown in Figure 3. The trapezoidal earth channel design developed by the CCCFCWCD was incorporated into this design.

1. Hydraulic Design

Design Flow

The improved channel was designed to pass the 100-year flood. Design flows for each stream reach are summarized below:

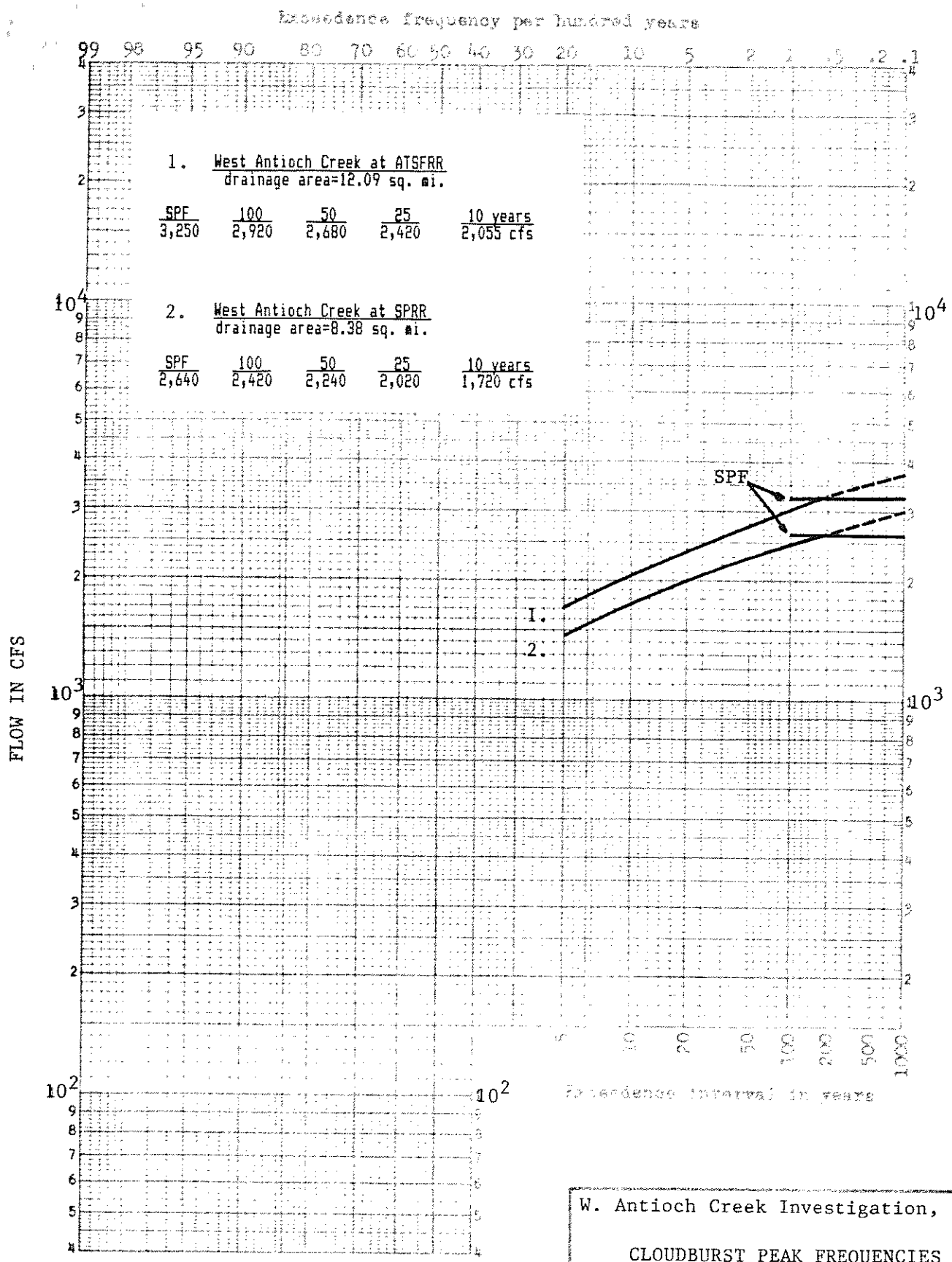
Reach	Design Flow (cfs)
1	2,920
2	2,920
3	2,420

Starting Water Surface Elevation

The water surface elevation downstream of the AT&SF RR is influenced by high tides. The design starting water surface elevation was based on the more conservative of the following two conditions:

a. A 100-year flood of 2,920 cfs concurrent with a 10-year tide of 2.9 feet.

00247



W. Antioch Creek Investigation, CA

CLOUDBURST PEAK FREQUENCIES
FUTURE LAND-USE CONDITIONS
YEAR - 2040

CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

JULY 1988

00248

FIGURE 2

b. A 10-year flood of 2,050 cfs concurrent with a 100-year tide of 6.5 feet.

The 100-year tide concurrent with a 10-year flood gave the more conservative starting water surface elevation.

Freeboard

The purpose of a freeboard allowance is to ensure that the desired level of protection will not be reduced by unforeseen circumstances unaccounted for in the hydraulic analysis. Freeboard requirements are as follows:

a. One foot for excavated channels.

b. Two feet for floodwalls.

c. One foot for existing bridges that would pass the design flow after modification.

d. Three feet for bridges that would be replaced because they would not pass the design flow after modification.

Roughness Coefficients

The following Manning's "n" roughness coefficients were used to determine water surface elevation:

a. 0.05 for earth channels below Somersville Road.

b. 0.04 for earth channels above Somersville Road.

c. 0.015 for concrete channels.

Riprap

Rock protection would be placed at all bridges, channel transitions and areas of high velocity. Rock size would be based on the expected maximum velocity.

2. Sediment Analysis

A sediment yield estimate was made for the West Antioch Creek watershed above the Contra Costa Canal using the Pacific Southwest Inter-Agency Committee's report "Factors Affecting Sediment Yield and Measures for the Reduction of Erosion and Sediment Yield," October 1967, as a guide. Results are summarized in Table 3.

Table 3
Preliminary Sediment Analysis

	Upper Basin	Lower Basin
Sediment Yield Classification	3	4
Drainage Area (sq. mi.)	8.82	3.27
Sediment Yield (A.F./sq.mi.)	0.78	0.26
Estimated Incremental Sediment Yield (A.F.)	6.88	0.85
Estimated Total Sediment Yield (A.F.)	7.73	--

This preliminary analysis indicates that about 89% of the sediment yield is recruited from the upper basin. Since this area is upstream of the study reaches, the implementation of a flood control project on lower West Antioch Creek would not substantially increase the sediment yield of the basin. Areas of sediment deposition ("sinks") and the amount of deposition in these sinks could change with a project. Sediment sinks include the stream channel, overbank area, marsh area and the San Joaquin River. By increasing the channel conveyance, less sediment would be deposited in the overbank area, and more sediment would be deposited in the other sediment sinks.

A sediment budget identifying the sediment sinks and the amount of deposition in those sinks with and without a project was beyond the scope of this study. However, based on the preliminary analysis of sediment yield, it is believed that sediment deposition can be controlled through channel maintenance. No additional sediment control measures were identified.

3. Operation and Maintenance

Operation and maintenance of the improved channel would include, but not be limited to, the following:

a. removal of excessive vegetative growth within the channel so as to maintain hydraulic roughness at approximate design conditions.

b. removal of excessive sediment deposited within the channel to ensure flow conveyance capability.

c. filling areas of scour that jeopardize project features.

d. replacement of rock protection as necessary.

00250

BASIS OF ECONOMIC ANALYSIS

The purpose of this section to describe the procedures used in computing future annual flood damages for without and with project conditions. The analysis is based on project implementation by 1993, a 50-year project life (1993-2043), October 1987 price levels, and an 8-5/8 percent interest rate. The streams within the study area were divided into reaches in order to evaluate them on an incremental basis. (These stream reaches are shown in Figure 3.)

1. Damage Analysis

Three steps were followed in estimating future flood damages: (1) estimates were made of the number and size of the physical units subject to flooding; (2) assessments were made of the existing and future values of the physical units; and (3) probability of flood damages occurring to the physical units was estimated.

Field surveys and aerial photographs were used to determine the number and size of physical units in the flood plain.

The values of existing properties in the flood plain were obtained from appraisal handbooks and personal interviews.

Depth-damage relationships were developed to estimate damages that would occur under different depths of flooding, either as a percentage of the total value of damageable property or the expected probable loss. These relationships were based on Federal Insurance Administration depth-damage curves and depth-damage curves from studies done by other Corps districts and government agencies. These relationships were developed for individual land use categories and depend on the type, age and condition of the structures, foundation heights, the localized characteristics of the terrain, and detailed cross sections of flood depths.

Damage-flow relationships were developed to estimate flood damages for various flood events. The flood damages that would result from a particular flood are estimated by delineating the flood plain area associated with that flood, inventorying this area by damage category and depth of flooding, and applying the appropriate depth-damage relationships for each category. Damage-flow relationships were developed for four flood events: 10-year, 25-year, 100-year and 500-year. The 500-year flood plain is shown on Figure 4.

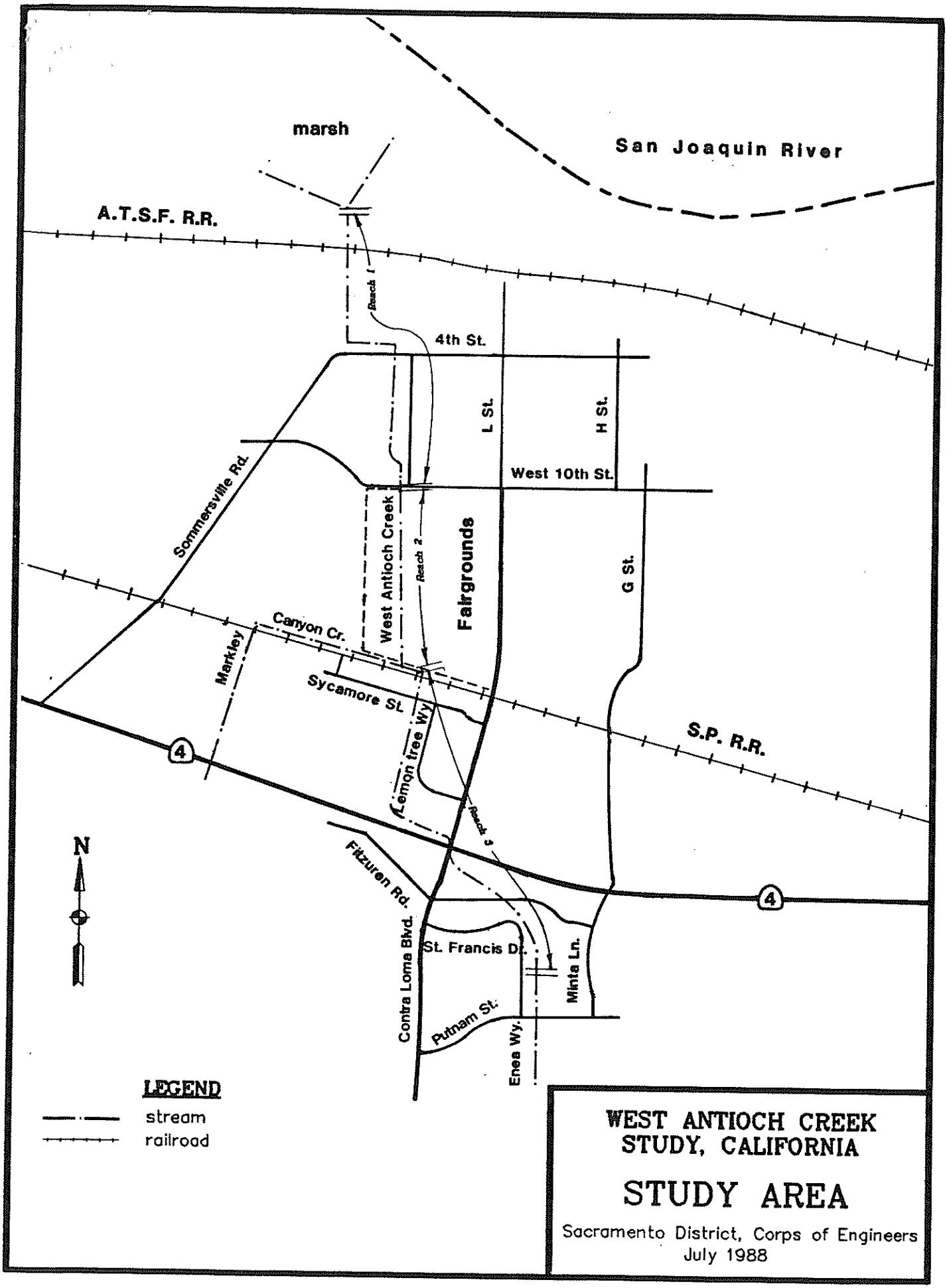


FIGURE 3

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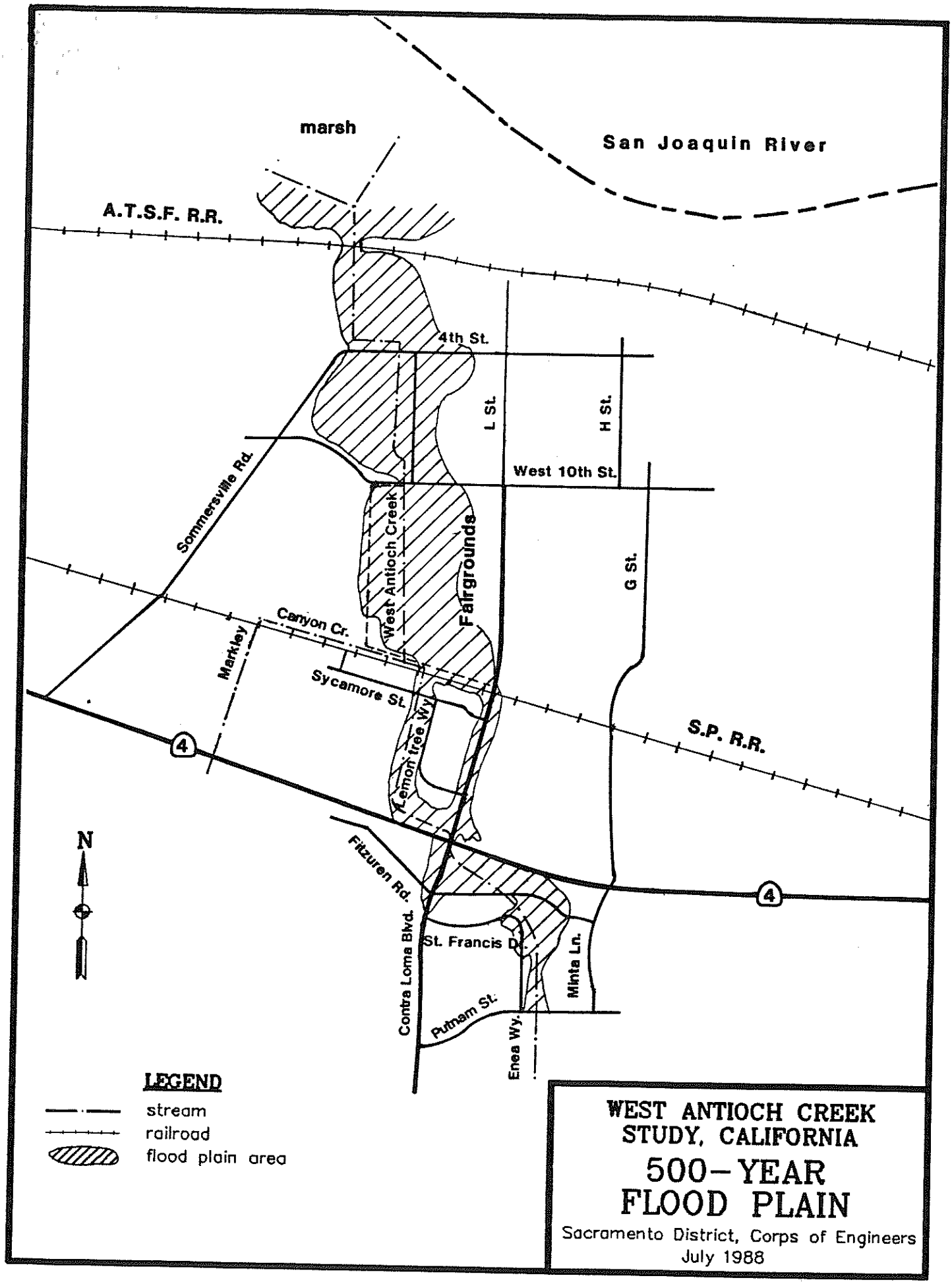

FIGURE 4

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Without project average annual damages were determined by integrating the area under the curve representing flood damages and probability of occurrence for present year, base year and annually through the period of analysis. Increases in peak flows due to changes in land use conditions during the period of analysis were minor and therefore not incorporated into the damage analysis. Average annual equivalent damages without and with a project for various levels of protection are summarized in Table 4.

Table 4
Average Annual Equivalent Damages
(October 1987 Price Levels - 8-5/8% Interest Rate - 50-year Project Life - $1,000)

Reach	Without Project Damages	With Project Residual Damages at Indicated Level of Protection (years) 25	50	100	500
1	194	34	14	7	1
2	5	1	negl	negl	negl
3	21	2	1	negl	negl
TOTAL	220	37	15	7	1

2. Benefit Analysis

Economic benefits considered in this study included inundation reduction and early bridge replacement benefits.

Inundation reduction benefits were estimated by evaluating damages without and with a project. The inundation reduction benefits are the difference between the equivalent average annual damages without a project and the residual average annual losses with a project.

Early bridge replacement benefits are calculated as that portion of the annual cost of a bridge replaced as a project feature from the time the existing bridge's economic life ends and the end of the project life.

ENVIRONMENTAL STUDIES

Environmental studies included a review and evaluation of available information on environmental and cultural resources in the basin. The results are presented in an Environmental Assessment (see Appendix A). In addition, the U.S. Fish and Wildlife Service evaluated the study area and prepared a Planning Aid Letter (PAL) on the fish and wildlife resources and potential impacts of the alternative plans. The Endangered Species Office also provided a list of the endangered, threatened and candidate species in the area. The PAL and this list are included as attachments to the Environmental Assessment.

CHAPTER V - ALTERNATIVE PLANS

This section describes the various flood control measures evaluated in this study. This evaluation was coordinated with the CCCFCWCD, and the major effort of this reconnaissance study was the evaluation of the CCCFCWCD plan of improvement. This plan consisted of channel improvements along lower West Antioch Creek. Other flood control measures that were evaluated included a no action plan and upstream detention basins.

NO ACTION

The no action plan was considered on all stream reaches. Under the no action plan, existing streamflow characteristics would not be modified, and existing fish and wildlife habitat would not be altered for the purposes of flood control.

With the no action plan, future storms would continue to cause flooding and related damages. The City of Antioch is currently enrolled in the National Flood Insurance Program (NFIP). However, even with the development restrictions imposed by the NFIP, there would continue to be substantial damages to existing development from future floods.

DETENTION BASINS

The purpose of upstream detention basins is to temporarily store floodflows and thereby reduce the flood peaks downstream. Since the topography of the upper West Antioch Creek basin consists of steep hills and deep ravines, this area is well suited for detention basins.

Currently, the two water supply reservoirs located in the upper basin are the Antioch Municipal Reservoir and the Contra Loma Reservoir. Although not specifically operated for flood control, both reservoirs store some floodflows from their respective subwatersheds. However, the hydrologic analysis of the basin indicated that neither of these two reservoirs could be operated for flood control without adversely impacting its current water supply operation.

Two additional sites on tributaries to Markley Canyon Creek were evaluated as potential detention basins (see Figure 1). As a result of the hydrologic analyses of these sites, it was concluded that neither site would provide a substantial reduction in the peak floodflows on lower West Antioch Creek. No additional sites were identified on other tributary streams in the West Antioch Creek basin.

CHANNEL IMPROVEMENTS

1. CCCFCWCD Plan

The CCCFCWCD plan extended from just downstream of the AT&SF RR upstream to the SPRR, a distance of about 6,000 feet. The plan included widening and deepening the existing channel to convey the 100-year flood. The 100-year design flow was based on hydrology developed by the CCCFCWCD. The improved channel would be a trapezoidal earth channel with 1:2 (vertical to horizontal) side slopes for most of its length. However, because of the close proximity of existing development to the stream channel, two sections of rectangular concrete channel were necessary to pass the design flow. The first section extended from 10th Street downstream a distance of about 650 feet. The second section extended from 4th Street downstream a distance of about 550 feet. In addition, the plan included short sections of floodwall, replacement of bridges, and a maintenance road adjacent to the improved channel.

To avoid adverse environmental impacts to the brackish marsh downstream of the AT&SF RR, the plan included a sedimentation basin located upstream of the AT&SF RR and an outlet pond downstream of the AT&SF RR. These features were designed to reduce the sediment load into the marsh area.

2. Corps Plan

The CCCFCWCD channel modification plan was evaluated as a potential flood control measure. The scope of this plan was expanded to include West Antioch Creek from just downstream of the AT&SF RR upstream to the section of improved channel downstream of Putnam Street. The evaluation of this plan was based on Corps criteria and guidance. In addition, the 100-year design flow was based on hydrology developed by the Corps. The study area was broken into three stream reaches (see Figure 3), and these reaches were evaluated on an incremental basis. Differences between the CCCFCWCD plan and Corps plan are described in the following paragraphs.

Channel improvements would begin in the brackish marsh downstream of the AT&SF RR, and the AT&SF RR bridge would be replaced. This was necessary to lower the starting water surface elevation for upstream improvements.

A preliminary analysis of the sediment yield of the West Antioch Creek basin did not indicate an unusually high sediment yield. Therefore, downstream sediment control measures including the sediment basin and outlet pond were eliminated from this plan. Sediment control would consist only of channel maintenance.

The Corps plan is similar to the CCCFCWCD plan upstream to the SPRR. The upstream end of the CCCFCWCD plan ties into existing channel improvements upstream of the SPRR. At this point the Corps plan continues upstream to the vicinity of Putnam Street. From the SPRR upstream to State Highway 4, several short sections of floodwall are necessary along the existing improved channel. At State Highway 4, the channel and the "L" Street underpass would be modified. Channel improvements from the underpass upstream to Putnam Street would be combination of trapezoidal earth channels (70 percent) with a 1:2 side slope (vertical to horizontal) and concrete rectangular channels (30 percent). The upstream end of the plan would tie into the existing channel improvements just downstream of Putnam Street.

In addition to the channel improvements, most of the bridges along West Antioch Creek would require modification or replacement.

Environmental impacts of the plan are discussed in the attached EA. Mitigation measures and their associated costs were not identified.

A cost estimate (by stream reach) of the channel plan is shown in Table 5. An economic summary of the plan of improvement (by stream reach) is shown in Table 6. The benefit-to-cost ratio of this plan (all stream reaches) is 0.51 to 1.0. While the plan of improvement would provide a high level of protection for lower West Antioch Creek, it is not economically feasible in terms of Federal participation.

Table 5
First Cost of Flood Control Features
(October 1987 Price Levels)

	Cost		
Feature	Reach 1	Reach 2	Reach 3
Channels	$2,796,000	$ 506,000	$1,228,000
Engineering & Design	336,000	60,000	147,000
Supervision & Administration	223,000	40,000	98,000
Sub-total	$3,355,000	$ 606,000	$1,473,000
Lands & Damages	$ 154,000	$ 188,000	$ - - -
Relocations	930,000	476,000	1,719,000
Sub-total	$1,084,000	$ 664,000	$1,719,000
Total	$4,439,000	$1,270,000	$3,192,000

00257

Table 6
Economic Summary
(October 1987 Price Levels - 8-5/8% Interest Rate - 50-yr Project Life)

	Reach 1	Reach 2	Reach 3
First Cost	$4,439,000	$1,270,000	$3,192,000
Annual Cost	$ 389,000	$ 111,000	$ 280,000
O&M	18,000	15,000	24,000
Total Annual Cost	$ 407,000	$ 126,000	$ 304,000
Annual Benefits	$ 251,000	$ 37,000	$ 141,000
Benefit-Cost Ratio	0.62	0.29	0.46

00258

CHAPTER VI - SUMMARY AND CONCLUSIONS

The purpose of this reconnaissance study was to evaluate potential flood control measures along West Antioch Creek and determine if there is a Federal interest in at least one feasible flood control plan. The major effort of this study was spent evaluating the CCCFCWCD plan of improvement. This plan provided the basis from which the Corps plan was developed. Differences between the Corps plan and the CCCFCWCD plan are described in Chapter V.

The plan developed by the Corps of Engineers had a benefit-cost ratio of less than 1.0 and therefore was not economically feasible. Economic feasibility is determined by weighing the benefits (flood damages reduced) provided by additional flood protection against the costs of that same flood protection. To ensure that all potentially feasible alternatives were considered, additional effort was spent evaluating the various technical analyses conducted and their effects on both sides of the benefit-cost ratio.

Both the Corps and the CCCFCWCD developed designs and costs for flood control plans that would provide 100-year levels of protection. These two design and cost estimates were in general agreement. Both plans included sections of concrete channel and floodwalls to convey the design flow through areas with residential, commercial and industrial development in close proximity to the existing channel. These flood control features represented a large share of the total project cost. Although only a 100-year level of protection was evaluated, it was concluded that concrete channels and floodwalls and their associated high costs would also be required for lower levels of protection (e.g., 25-year). Therefore, a plan providing a lower level of protection would still not be economically feasible.

The plan developed by the Corps of Engineers was evaluated incrementally on three separate stream reaches. Of these three stream reaches, reach 1 contains the majority of damageable property, including commercial, industrial and residential developments. Historically, reach 1 has incurred the majority of flood damages from past floods in the West Antioch Creek basin. Therefore, additional study efforts focused on this reach only. Reach 1 extends from the AT&SF RR upstream along West Antioch Creek to West 10th Street.

Two aspects of the hydrologic analysis and their impacts on the economic analysis were studied. First, an analysis of the sensitivity of the average annual damages to the frequency of the nondamaging flow was conducted. This was done by varying the frequency of the nondamaging flow and determining the related changes in the average annual damages. The nondamaging flow was determined by identifying the elevation at which flood damages would first occur, and the magnitude of this flow was determined from a hydraulic analysis. Results of this analysis indicated that a very frequent nondamaging flow (1-1/2 years) resulted in increased damages (and benefits associated with the plan). Even with these increased benefits, however, no economically feasible plan could be identified.

The second aspect involved the two separate hydrologic analyses that were conducted for the West Antioch Creek basin. The CCCFCWCD conducted a hydrologic analysis when developing their flood control plan. In addition, the Corps of Engineers conducted a hydrologic analysis as part of this reconnaissance study. Each of these studies resulted in substantially different peak flows for specific frequencies.

Two separate damage analyses were conducted using the results of the two hydrologic analyses. The peak flows and associated frequencies are input into the economic analysis and relate the probability that a flood event will occur to the amount of flood damages associated with that event. Although the estimated flood damages and benefits were higher with the CCCFCWCD hydrology, an economically feasible plan still could not be identified.

Three conclusions can be made based on the reconnaissance studies. First, flooding problems currently exist along West Antioch Creek. Second, the need exists in the study area for additional flood control. Finally, none of the proposed flood control plans are economically justified and therefore do not warrant continuation of planning studies at this time.

APPENDIX A

Environmental Assessment

ENVIRONMENTAL ASSESSMENT

WEST ANTIOCH CREEK
FLOOD CONTROL

U.S. Army Corps of Engineers
Sacramento District

June 1988

ENVIRONMENTAL ASSESSMENT

WEST ANTIOCH CREEK

FLOOD CONTROL

ABSTRACT

This environmental assessment (EA) describes impacts of a proposed alternative and the without project condition (No Action). Impacts would result from channel enlargement, clearing of riparian and upland vegetation, dredging, maintenance, and relocation of existing channels. Mitigation could be implemented on areas along the project stream reaches. Due to potential significant impacts, this EA concludes that an Environmental Impact Statement (EIS relating to loss of scarce wildlife cover in an urban setting) will be required.

If you would like further information on the alternatives addressed in this EA, please contact: Mr. Phil Turner, U.S. Army Engineer District, Sacramento; 650 Capitol Mall; Sacramento, California 95814-4794; Telephone (916) 551-1855.

ENVIRONMENTAL ASSESSMENT
WEST ANTIOCH CREEK
FLOOD CONTROL

TABLE OF CONTENTS

1. Major Conclusions and Findings - An Environmental Impact Report (EIR) was completed in February 1985 for the Contra Costa County Flood Control and Water Conservation District (CCCFCWCD) on alternative flood control improvements to West Antioch Creek. This EA describes impacts of an alternative that consists of channelization, relocation, and vegetation clearing of portions of West Antioch Creek. Increased flood protection would be provided to residential, commercial, and industrial areas. Resources that could be affected include riparian, marsh, and upland vegetation, aquatic habitat, endangered species, wildlife, and cultural resources. This environmental assessment concludes that an EIS will be required to fully address all potential impacts of the project alternatives.

2. Purpose of Investigation - The primary objective of the reconnaissance study is to determine if there is a Federal interest in added flood control measures on West Antioch Creek. This determination is made by appraisal of the costs, benefits, and environmental impacts of the alternatives.

3. Study Authority - The authority for this investigation comes from Section 205 of the Flood Control Act of 1948, as amended (33 USC 701S).

4. Need for Project - Local agencies have expressed the need to reduce significant problems of flooding along West Antioch Creek. Recent flooding has impacted fairgrounds, an auto dealership, a motel/restaurant, several apartment complexes, and a glass container manufacturing facility. Flood problems result from excess runoff that overflows onto lands adjacent to drainage canals.

5. Description of Project Area -

a. The West Antioch Creek watershed extends from the marshes along the San Joaquin River to rugged terrain reaching elevations of 1,500 feet (see figure 1). The northern portion of the watershed is a relatively flat alluvial plain with tidelands adjacent to the river. The southern portion of the watershed consists of rolling hills that grade into mountainous terrain with narrow, steepsided ravines and canyons. Upland areas are dominated by well-drained clayey soils on soft shales, while low areas are predominantly excessively drained sandy soils.

b. The project area is near the boundary of the Sacramento Valley and San Francisco air basins and is characterized by a semi-arid climate. Winds blowing out of the west through Carquinez Strait provide a major source of ventilation, especially during the summer months. Temperatures in the area are mild throughout the year. Average annual rainfall varies with elevation, averaging about 12.5 inches in the project area. The Bay Area Air Quality Management District maintains an air quality monitoring station in the City of Pittsburg, less than five miles from the project area. Recent data show that the air is sometimes

West Antioch Creek Improvement

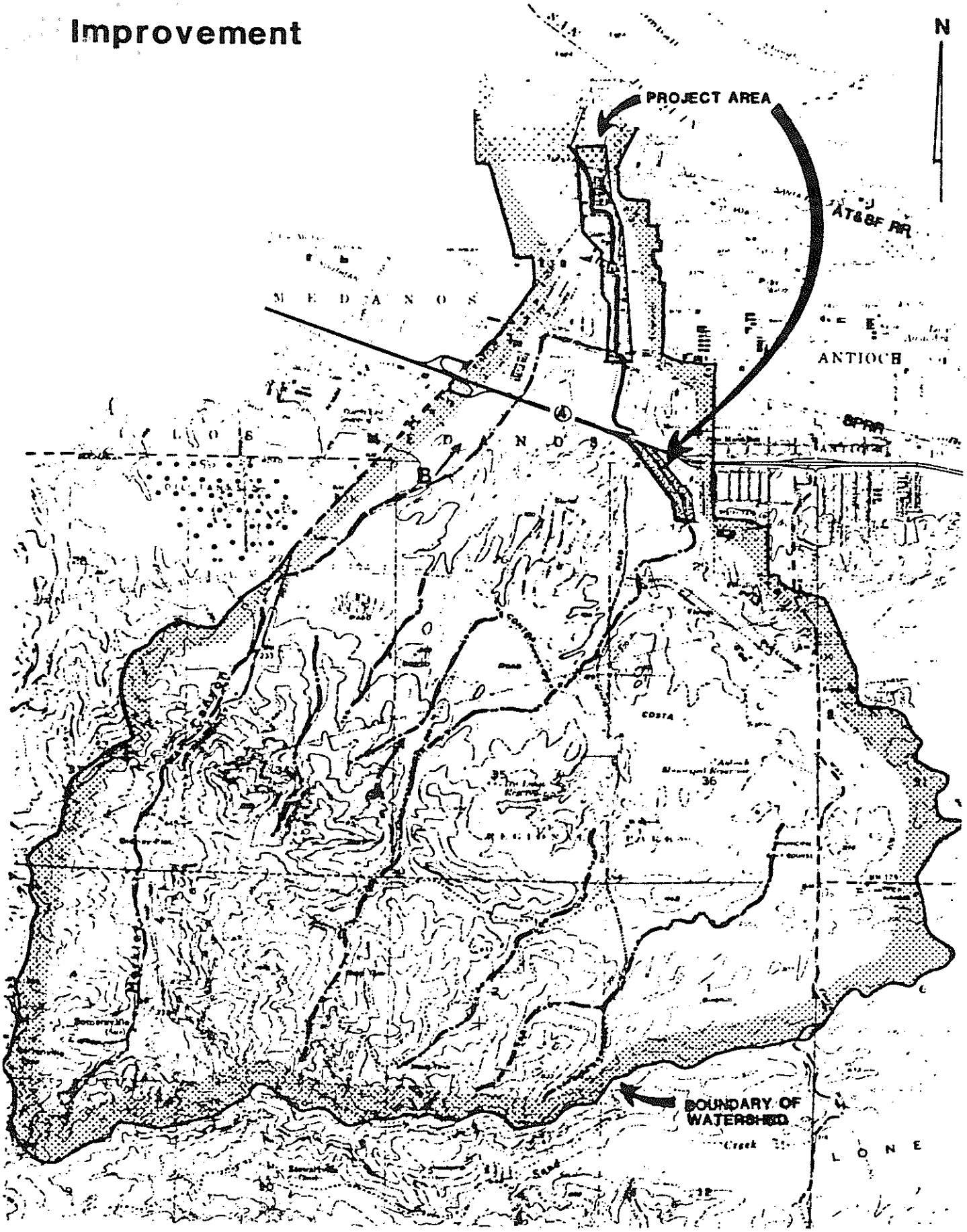

Figure 1

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in violation of standards set for total suspended particulates. The particulate matter within the air has been attributed to natural sources such as windblown dust and pollen, while manmade sources include automobiles, burning, and earth-moving activities. The level of ozone rarely exceeds standards, but has been violated in the past. Sources of oxidants include automobile exhaust.

c. West Antioch Creek north of Highway 4 has been classified as a perennial stream, while all tributaries are classified as intermittent streams. The volume of surface runoff during summer months consists chiefly of urban return waters containing detergent, grease, oil, and litter. As a result of the above flows, West Antioch supports a meager fish population consisting primarily of mosquito fish.

d. Vegetation north of the Atchinson, Topeka and Santa Fe (AT&SF) Railroad consists of emergent brackish marsh and riparian species. The marsh, which is subject to tidal action, is composed of both fresh and salt-water species including pickleweed, salt grass, gumweed, brass button, cattail, bulrush, sedges, and rushes. A willow thicket exists adjacent to the marsh consisting of primarily arroyo willow and blackberry. Immediately upstream of the AT&SF railroad, vegetation consists primarily of willow and blackberry. Several trees are located near the Riverview Fire Protection District administrative offices and include eucalyptus, redwood, black locust, black walnut, and Monterey pine.

Upper reaches of West Antioch Creek are generally lacking in riparian vegetation, other than rushes and sedges. Vegetation along the banks of the creek primarily consist of annuals and include wild oat, wild mustard, wild radish, filarea, dock, and plantion. The improved reach of creek downstream of Highway 4 to about Sycamore Drive has extensive non-woody riparian vegetation in the channel bottom, with an occasional willow.

e. The marsh adjacent to the San Joaquin River provides habitat for a variety of wildlife. Birds utilizing the area include the great blue and the green herons, belted kingfisher, long-billed marsh wren, and various waterfowl. Other wildlife utilizing the area include muskrat, skunk, raccoon, and small rodents. The Endangered Species Office of the U.S. Fish and Wildlife Service identified the federally-listed endangered salt marsh harvest mouse and nine candidate species as possibly occurring in the project area. Candidate species include the California black rail, curved-foot hygrotus beetle, Antioch andrenid bee, Yellow-banded andrenid bee, a land snail, Suisun aster, soft bird's-beak, Delta tule pea, and Mason's lilaeopsis. The stream reaches of the creek provide limited riparian and upland habitat for wildlife. Wildlife species that utilize such areas include mourning dove, scrub jay, brown towhee, white-crowned sparrow, and jackrabbit. The creek also serves as movement corridors for a variety of wildlife that are able to live in close proximity to man.

f. A literature review by the Northwest Information Center, Sonoma State University, shows that there are no known prehistoric or historic archeological resources within the project area. A previous archeological survey included the lower portion of the project area; however, none of the remainder has been intensively surveyed on the ground.

Riverview Union High School on West Fourth Street and Somersville Road opened in 1910 and is considered a historic landmark of Contra Costa County. Other historic structures have been identified in the City of Antioch. None of these is within the project area.

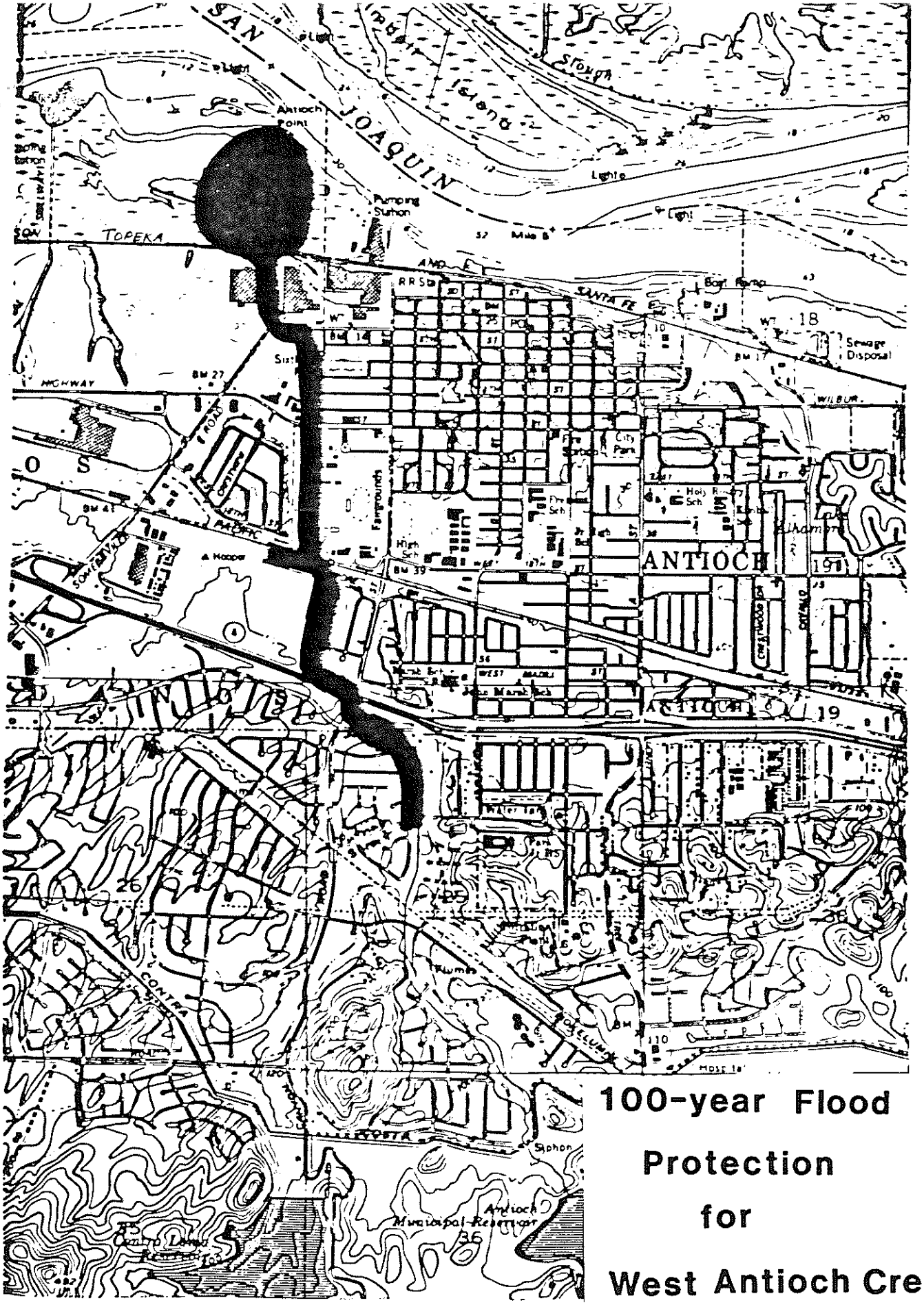
g. Approximately 240 acres located between Putnam and the AT&SF railroads are subject to inundation by the West Antioch Creek 100-year flood event. Much of the area currently has a 2- to 5-year level of flood protection. Development in this portion of the watershed is a mixture of industrial, commercial and residential. Flood damages during the 1982 and 1983 storms occurred at the fairgrounds, an auto dealership, a motel/ restaurant, several apartments and businesses on "O" Street, the City Maintenance Services Center, and the Glass Containers Corporation. In addition, traffic in the northwest area of the City of Antioch was paralyzed due to road closures.

h. The City of Antioch has a population of 51,800. In 1983, the average income was $20,892 per household with a per capita income of $9,980. The average home value in 1980 was about $92,000. Land bordering West Antioch Creek in the project area is utilized for residential, industrial, commercial, and recreation purposes. Much of this area currently has a 10-year level of flood protection and has been flooded several times in the 1980's.

6. Alternatives Evaluated - The flood control alternatives considered in this report include the No Action and the Earth-lined Channel alternatives.

No Action - The No Action alternative assumes that the Federal government would take no action to alleviate flood problems on West Antioch Creek. Areas along the Creek would remain subject to flooding by runoff exceeding the 2- to 5-year flood event.

Earth-lined Channel - This alternative would provide 100-year flood protection along West Antioch Creek downstream of Putnam Street (see figure 2). This alternative would consist of enlarging the existing channel at a point immediately below the improved channel near Putnam Street and terminating immediately below the culvert under Highway 4. Downstream of the Highway 4 culverts the channel has already been improved until it reaches Sycamore Drive. Channel enlargements would begin again downstream of Sycamore Drive on West Antioch Creek. Channel improvements would also be accomplished on Markley Creek, immediately above its confluence with West Antioch Creek. Channel enlargement would continue to



100-year Flood Protection for West Antioch Creek

Figure 2

00269

the AT&SF railroad. In addition to channel enlargement, numerous culverts would be enlarged to permit passage of the 100-year flood flows. Several bridges would be replaced including the existing bridge at Somersville Road. The majority of West Antioch Creek would be a trapezoidal earth-lined channel, while portions would be a concrete channel. Between West Tenth Street and Somersville Road portions of the creek would be realigned to eliminate existing 90 degree bends. A portion of the old creek would be abandoned as a result of the relocation. Two alternatives exist for the areas downstream of Somersville Road. The feasibility of constructing a sedimentation basin to trap sediments is being investigated. The basin would prevent heavy materials originating from upstream development from covering and thereby degrading the marsh. This EA assumes materials transported from upstream are resulting from induced erosions and thereby are detrimental to the existing environment. If future studies determine the sediment to be a natural process, the need for a sediment basin would be reexamined. The possibility of constructing a channel from the AT&SF railroad through the marsh is also being studied. This would impact the marsh where the construction occurred, but would transport the sediments away from the marsh and into the San Joaquin River.

7. Environmental Effects of Earth-lined Channel Alternative - This section presents the environmental effects of three possible features of the earth-lined channel alternative that include channelization along the stream reaches, a sedimentation basin, and an outlet channel through the marsh. The environmental effects of each of these features is presented separately below and summarized in table 1.

Earth-lined Channel

a. Impacts to Vegetation - Flood control improvements to the channel of West Antioch Creek would destroy about 17.7 acres of vegetation along the stream. This vegetation consists of about 14 acres of upland vegetation and 3.7 acres of riparian vegetation. Much of the upland vegetation is annually disced by local entities and consists of annual grasses. Several trees located near the Riverview Fire Protection District Administrative Offices may also be lost. These include a small grove of eucalyptus, several redwood and black locust, black walnut and Monterey pine. Woody riparian vegetation consisting of willows would be eliminated at the confluence of Markley and West Antioch Creeks. These losses would substantially reduce the existing feeding, nesting and resting grounds, and shelter for wildlife in this area. Channelization of the creek would prevent overbank flooding on West Antioch Creek during flood events of magnitudes up to the 100-year level. This would increase sediment loads within the channel. This sediment would be carried down the creek and deposited either in a sediment basin, in the marsh below the creek, or in the San Joaquin River. If the sediments were

Table 1
Comparative Impacts of Alternatives

Alternatives	Vegetation	Wildlife	Endangered Species	Aquatic Resources
No Action	Riparian vegetation along creek reaches would continue to be subject to maintenance activities. Existing marsh vegetation to remain.	Wildlife values along the creek reaches and in the marsh would not be expected to significantly change.	Habitat suitable for the endangered salt marsh harvest mouse and nine candidate species would remain.	Fish habitat within stream reaches would remain relatively poor. Marsh habitat remain valuable.
Earth-lined Channel				
-Creek Channelization	3.7 acres of riparian and 14 acres of upland vegetation destroyed. Mitigation along project reaches. Maintenance within channel would limit growth. Vegetation in marsh may be impacted by increased sediment load in creek.	Wildlife habitat within and adjacent to project stream reaches would be initially destroyed. Mitigation would replace habitat loses. Habitat in the marsh may be impactd by increased sediment deposition	Habitat suitable for the salt marsh harvest mouse and two candidate invertebrates would be lost along the stream reaches. Habitat suitable for the above species and an additional seven candidate species may be impacted as a result of increased sediment deposition in the marsh.	The poor fish habitat within the stream would be virtually eliminated. Benthic organisms in the marsh could be impacted by increased sediment deposition.
-Sedimentation Basin	1.2 acres of riparian and 1.8 acres of upland vegetation destroyed. Would keep heavy sediments from covering marsh vegetation while fine sediments would continue to impact marsh.	Wildlife habitat would be lost at the basin area. Habitat would be protected in the marsh by keeping out heavy sediments, but fine sediments would continue to enter marsh.	Habitat suitable to the above species would be lost at the basin area, but remaining would be protected from heavy sediments.	Some benthic organisms could be impacted by basin development, but would protect aquatic resources in remainder of marsh from heavy sediments.
-Channel Through Marsh	.2 acres of riparian vegetation and 1.2 acres of marsh vegetation destroyed. Rest of marsh vegetation protected from sedimentation buildup.	Habitat would be lost where channel located; however, remainder of marsh protected from sedimentation accumulation.	Habitat suitable to the above species would be lost where channel is excavated, protection provided from sedimentation accumulation.	Channel construction through the marsh would damage aquatic resources along the length of the channel while preventing the accumulation of sediments in the marsh.

deposited into the marsh, the marsh would fill in sooner than without the project, eventually converting the marsh and its vegetation to upland habitat.

b. Impacts to Wildlife - Riparian and upland habitat utilized by a variety of wildlife along the creek would be destroyed as mentioned above. Much of this vegetation provides limited habitat due to its sparseness and close proximity to man. Some wildlife habitat would remain, however, by the allowance of grasses to revegetate the earth-lined channel sections. Periodic channel maintenance would not permit the development of vegetation growth within the channel that would reduce the channel flow capacity. If sediments from the improved channel are deposited into the marsh north of the AT&SF railroad and the marsh subsequently reverts sooner to uplands, there would be a significant reduction in food, shelter, nesting, and nursery habitat available to fish and wildlife in the ecoregion.

c. Impacts to Endangered Species - No endangered or threatened species of plant or animal are known to inhabit the reaches of the creek proposed for channelization. However, the endangered salt marsh harvest mouse and the candidate Antioch and yellow-banded and renid bee species that are known to reside in similar habitat may be impacted along project stream reaches. If the species mentioned in section 5.e. were present in the marsh, increased sediment deposition into the marsh could reduce its habitat. A field survey would be conducted during the feasibility study phase to determine whether these species are present and adversely affected. A biological assessment with this information will be coordinated with FWS at that time. Formal consultation would be initiated if adverse impacts are found.

d. Impacts to Aquatic Resources - The enlargement of the existing channel and portions of West Antioch Creek and the elimination of sharp channel angles by channel relocation would destroy the existing limited aquatic resources within the project reaches of the creek. Once construction is completed, the creek project area would be expected to support fish and other aquatic species similar to those presently occurring especially since such resources are currently limited in the creek. If increased sediment deposition occurs in the marsh, valuable food, shelter, nesting, and nursery habitat available to fish could be lost.

e. Impacts to Cultural Resources - In the future planning stages, an intensive cultural resources survey and evaluation will be undertaken to identify those cultural sites that may be eligible for the National Register of Historic Places. The probability of cultural sites for this immediate area is low; however, it is possible that buried archeological deposits may occur. All actions regarding the cultural resources survey and mitigation and/or protection of any sites eligible for the National Register will be coordinated with the State Historic

Preservation Officer and the Advisory Council of Historic Preservation in accordance with the National Historic Preservation Act of 1966, Section 106, process.

If impacts to any such National Register eligible sites cannot be avoided, mitigation would probably consist of a data recovery program through excavation of the sites. Up to 1 percent of total Federal project funds may be spent for such mitigation.

f. Hydrology and Flood Hazards - Flood protection levels would be raised to the 100-year level for locations within the project area that currently have a 2- to 5-year degree of flood protection. This would provide additional protection to a fairground, numerous businesses, industrial areas, and apartment complexes. In addition, several roads would no longer be closed in the northwest area of the City of Antioch by flood waters as these waters would be contained within the channel. If some vegetation clearing and channel work is not accomplished in the marsh, the 100-year event could not be passed under the AT&SF railroad.

g. Impacts to Air Quality - Short-term air quality impacts would be expected. These impacts would primarily include increased dust and vehicular exhaust emissions during construction periods resulting from operations required to excavate for and to construct the proposed improvements.

h. Impacts to Social Conditions - Commercial, industrial, residential, and recreation areas would be provided 100-year flood protection within the project area. Flooding would be reduced at the fairgrounds, the glass containers corporation, several apartments and businesses and other areas. Construction of the channel improvements would permanently reduce some of the parking areas available at the fairgrounds. This could lead to increased off-site parking during fair activities. Construction activities would temporarily add noise, dust, and contribute to traffic congestion within the project area.

i. Impacts to Land Use - Channel enlargement and relocation would convert some of the existing land uses that are industrial, residential, commercial, open space and recreation in nature to flood control uses. Up to 5 acres of the fairground would no longer be usable for parking. Use of upland areas bordering the creek would also be converted to flood control purposes. Some of these areas could be revegetated as part of the wildlife habitat mitigation features. Since areas along the creek would be provided 100-year flood protection, some development may occur as a result of the project.

Sedimentation Basin

a. Impacts to Vegetation - Development of the basin would eliminate about 3 acres of vegetation. This vegetation would consist of about 1.8 acres of annual grasses and 1.2 acres of riparian plants. The riparian vegetation consists primarily of willow and

blackberry. The occasional maintenance of the basin would include removal of vegetation and accumulated sediment. The basin would trap heavy sediments that would otherwise be deposited into the marsh. The basin is not expected to stop fine sediments from entering the marsh.

b. Impacts to Wildlife - Upland and wildlife habitat used by a variety of wildlife would be destroyed by the development of the basin. The basin would provide some habitat for wildlife, but occasional maintenance of vegetation and removal of sediments would diminish its value to wildlife. Songbirds, small mammals, raptors, migratory birds, reptiles and amphibians are some of the wildlife that would be impacted. The basin would help protect the marsh to the north which has a high value to wildlife.

c. Impacts to Endangered Species - No endangered or threatened species of plant or animal are known to inhabit the proposed basin area. However, all of the species listed in section 5.e. reside in similar habitat. Any of them residing in the area of the sedimentation basin would be impacted by reduced habitat and construction and maintenance activities. Since the basin would reduce the amount of sediments carried into the nearby marsh, habitat for any threatened or endangered species located there would be improved.

d. Impacts to Aquatic Resources - Construction of a settling basin would adversely impact existing aquatic resources located immediately south of the AT&SF railroad. The basin would trap heavy sediments carried by the creek thus protecting the downstream marsh from being buried. Fine material would continue to be carried into the marsh. Aquatic resources at the basin area would be constantly disturbed by periodic maintenance and sediment removal.

e. Impacts to Cultural Resources - see earlier discussion.

f. Impacts to Hydrology and Flood Hazards - The sediment basin would have little effect on hydrology or flood hazards. Heavy sediments would be captured in the basin prior to the creek entering the marsh.

g. Impacts to Air Quality - Construction of the basin would also have short-term air quality impacts. These impacts would primarily include increased dust and vehicular exhaust emissions during construction periods.

h. Impacts to Social Conditions - Development of the basin is expected to have little impact on social conditions, except that it would protect the marsh which many agencies, groups, and individuals find valuable.

i. Impacts to Land Use - The basin would convert up to 1.6 acres of existing riparian & upland vegetation and the existing creek channel to a flood control structure.

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Channel Through Marsh

a. Impacts to Vegetation - A forty-foot-wide channel through the marsh north of the AT&SF railroad to the San Joaquin River would eliminate about .2 acres of riparian vegetation consisting mostly of blackberry and willow and 1.2 acre of marsh vegetation consisting of both freshwater and saltwater species. Additional impacts to vegetation would be expected from construction vehicles moving about in the marsh. Vegetation that grows within the channel would be periodically controlled to maintain the flow capacity of the channel. The channel would deposit both coarse and fine sediment into the San Joaquin River and away from the marsh.

b. Impacts to Wildlife - Wildlife utilizing the marsh would be permanently displaced by the construction of the channel. Construction activities would also temporarily disturb wildlife in the vicinity of the channel until the work is completed. Periodic maintenance of the channel would occasionally disturb additional wildlife within the marsh. The channel would help protect wildlife habitat by decreasing the amounts of sediment carried into the marsh.

c. Impacts to Endangered Species - About 1.4 acres of habitat that may be utilized by the species listed in 5.e. would be lost. Construction activities would also temporarily disturb any of the above listed species located near the channel. Periodic maintenance would also disturb any species present. The channel would help reduce the deposition of sediments within the remaining area of the marsh, thus promoting endangered species habitat.

d. Impacts to Aquatic Resources - Construction of the channel through the marsh would adversely impact the existing resources present. Up to 1.4 acres of marsh habitat would be destroyed where the work is accomplished. Vegetation that re-established itself in the channel would be periodically removed to maintain the channel capacity. The channel would transport West Antioch Creek sediments into the San Joaquin River, not allowing them to be deposited within the marsh. This would reduce sediment transfer into the marsh to below pre-project levels, thus protecting the marsh and its varied resources from being buried.

e. Impacts to Cultural Resources - see earlier discussion.

f. Impacts to Hydrology and Flood Hazards - The outlet channel into the marsh is needed to negate back water effects caused by high tides. If the channel were not constructed at least somewhat into the marsh, flooding would occur upstream during the 100-year event as flows would not be able to pass through the marsh. The channel would allow floodflows to either pass into the San Joaquin River directly, or at least well into the marsh and away from developed areas.

00275

g. Impacts to Air Quality - Construction of the outlet channel would have short-term air quality impacts. These impacts would primarily consist of increased vehicular exhaust emissions during construction periods.

h. Impacts to Social Conditions - Development of the channel through the marsh would have some impact on social conditions as the 100-year floodflow would be contained within the channels of West Antioch Creek and not cause flooding along the downstream reaches of the creek. Other social impacts include degradation of that part of the marsh that is converted to a channel. The channel could impact Delta Landing, a proposed development in the marsh.

i. Impacts to Land Use - The channel through the marsh would convert about 1.4 acres of riparian and marsh vegetation into a flood control structure.

8. Mitigation - Several possible mitigation measures have been identified to date. The California Department of Fish and Game (DFG) in a letter to Contra Costa County dated November 6, 1984, suggested that the primary opportunities to mitigate project impacts onsite exist upstream from the AT&SF railroad. However, DFG wasn't able to determine if riparian vegetation would be compatible on the earth channel, if side slope were 2:1. They believed a 3:1 slope would be compatible. The U.S. Fish and Wildlife Service has recommended inclusion of the settling basin as a project feature to reduce the sediment load carried into the marsh. The Contra Costa County Planning Commission recommended that plantings of native riparian species should be planted intermittently along the creek and that landscaping should be installed to restore vegetation along the trapezoidal earth channel and basin. The Commission also recommends that a study should be accomplished to determine if the large trees near the Riverview Fire Protection District facility could be saved by the use of retaining walls or some other means. The Draft Environmental Impact Report for West Antioch Creek accomplished for Contra Costa County recommends that work done in the marsh should be limited to the period from late August to the end of September. Willow, cottonwood, black walnut, elder and valley oak are recommended for planting intermittently along the length of the project.

Mitigation for adverse impacts to fish and wildlife related resources from channel enlargement and related work would be determined by the use of the FWS Habitat Evaluation Procedure (HEP) during the project feasibility phase. A program to monitor the success of mitigation measures and their operation and maintenance would also be developed at that time. Participants in the study would include the Corps, FWS, and DFG.

9. Enhancement - No enhancement features have been identified to date. During the future feasibility study additional study and coordination with the FWS and potential sponsors will continue regarding fish and wildlife enhancement.

10. Public Involvement - In June 1984, Contra Costa County finished a Draft Environmental Impact Report having a review period extending from September 4, 1984, to February 8, 1985. On January 29, 1985, a hearing was held by the Planning Commission. After hearing testimony on the draft, the hearing was closed, with the period for receiving written comments left open until March 8, 1985. On March 26, 1985, after considering comments received and responses, the Planning Commission certified that the environmental documents described above constituted a final Environmental Impact Report.

In June 1987, the Corps of Engineers circulated a notice of Initiation of Investigation for Flood Control on West Antioch Creek to interested individuals, agencies, and affected parties. The notice described the general project limits and invited comments. Eight responses were received, comments ranging from an incorrectly labeled map to the need for increasing flood protection.

11. Additional Studies Needed - The following paragraphs list environmental studies that would be accomplished during a feasibility study. Each study would require accompanying coordination with interested agencies, organizations, and the public. The feasibility phase would continue after the current reconnaissance phase, provided a non-Federal agency agrees to share 50 percent of study costs and there is at least one likely feasible alternative with a Federal interest.

a. Preparation of a Draft & Final Environmental Impact Statement addressing reasonable alternatives would be accomplished to evaluate the environmental effects. This report would be coordinated with Federal, State, and local governments and agencies as well as interested groups and individuals.

b. Preparation of an Endangered Species Act Section 7 Biological Assessment. This would involve conducting on-site inspections of the area affected by the alternative to determine if listed or proposed species are present and whether suitable habitat exists on the project. Species distribution and habitat needs would be determined. The effects of the proposal would be reviewed and analyzed and a report prepared documenting the results would be provided to the FWS Endangered Species Office.

c. Preparation of FWS Coordination Act Report. The report would refine environmental effects of the selected alternative, summarize the HEP finding, and recommend mitigation measures acceptable to FWS.

d. A field survey to locate and evaluate cultural sites would be undertaken and a report developed. Coordination with State Historic Preservation Officer, National Park Service, and Advisory Council on Historic Preservation.

e. FWS conduct HEP to define impacts and determine amount of required mitigation. This on-the-ground study would evaluate baseline conditions, evaluate project induced environmental effects, and help determine types and amounts of mitigation for habitat losses.

f. Mitigation plans refined and a monitoring program developed. Areas suitable for mitigation would be identified. A plan would be developed to establish habitat lost as a result of the project. A monitoring project would be developed to record the success of the mitigation measures.

g. Further development of a public involvement program and implementation.

h. 404 b(1) evaluation of water quality impacts and coordination with State and Federal water quality agencies to ensure adequate consideration has been given and to acquire water quality certification.

i. A stream survey of West Antioch and Marklee Creeks is recommended to determine if migratory and/or resident fish inhabit the streams.

j. Additional information is required to determine sources and types of materials transported by the creek. Such information is required to determine the need for a settling basin and the nature of any potential impacts on wetland areas.

12.0 List of Preparers

Name	Discipline/ Expertise	Experience	Role in Preparing EA
Patti Johnson	Archeology	8 years cultural resource studies, Sacrament District; 13 years cultural resources experience, private practice and State of California.	Cultural evaluation
Fred Kindel	Environmental Planning/Biology	23 years environmental planning; Sacramento District; 8 years private and State employment as a game biologist.	Report review and editing
Jeffrey W. Groska	Water Resources Planner	2 years Environmental Planner, Sacramento District; 5 years Study Manager, Detroit District; 2 years report preparation, Detroit District; 1 year Hydrographic Survey, Detroit District.	Report review and editing
Mark Schoening	Civil Engineering	3 years water resources planning studies, Sacramento District Corps of Engineers;	Planning Engineer, study manager, formulation of alternatives
Phil Turner	Outdoor Recreation Planning/ Wildlife Management	3 years Outdoor Recreation Planner, 5.5 years Park Ranger, Sacramento District; 2 years Biological Technician, National Marine Fisheries Service; 3 years Yolo County Agricultural Department; 1 year California Fish and Game.	EA Coordinator, Report Preparation
Liz Davis	Social Science Technician	.5 years Social Science Tech, 1.5 years Program Support Clerk, Sacrament District, COE	Social Impact Evaluation

13.0 References

Contra Costa County; June 1984. Draft Environmental Impact Report for West Antioch Creek Improvements. Darwin Myers Associates, Pleasant Hill, California.

_____. February 1985. Final Environmental Impact Report for West Antioch Creek Improvements.

00280

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Division of Ecological Services
2800 Cottage Way, Room E-1803
Sacramento, California 95825

September 9, 1987

Colonel Wayne J. Scholl
District Engineer
Sacramento District, Corps of Engineers
650 Capitol Mall
Sacramento, California 95814

Subject: CE - West Antioch Creek Flood Control Project, Antioch, Contra Costa County, California

Dear Colonel Scholl:

This responds to your August 5, 1987 request for a planning aid letter regarding impacts to fish and wildlife of the proposed flood control improvements presently being considered for West Antioch Creek. The information provided herein is preliminary in nature and is provided as technical assistance to aid your planning process. This letter does not constitute our detailed report as described in Section 2 of the Fish and Wildlife Coordination Act. This letter is based on (1) project information provided by the Corps of Engineers prior to August 31, 1987, and (2) information gathered during the August 4, 1987 site investigation.

DESCRIPTION OF THE PROJECT AREA

The area of concern is located in the northern section of the West Antioch Creek watershed, Contra Costa County. West Antioch Creek drains an area of about 12 square miles. The creek flows northerly through the City of Antioch and its sphere of influence where it is heavily abutted by residential, commercial and industrial development. Much of the creek within the project area has been improved for flood drainage and is periodically dredged. Marklee Creek joins West Antioch Creek along the Southern Pacific Railroad right-of-way about 6,000 feet upstream of the San Joaquin River. Historically, West Antioch Creek and other creeks in the watershed were classified as intermittent streams; however, because of increased drainage from summer irrigation in the lower watershed, lower West Antioch Creek maintains minor flows year-round.

DESCRIPTION OF ALTERNATIVES

No Project Alternative

Under this alternative, drainage improvements would not occur. Seasonal flooding of lands adjacent to the lower reach of West Antioch Creek would continue to occur.

00281

ATTACHMENT A

Earth Channel and Sedimentation Basin

Under this alternative, much of the two miles of West Antioch Creek between Putnam Street and the Atkinson Topeka and Santa Fe (AT&SF) Railroad would be excavated to form an 80 to 90-foot-wide, trapezoidal, earth channel (2 horizontal to 1 vertical slope), including a 20-foot-wide service road. The channel would include a short reach of rectangular concrete culvert in the vicinity of the car dealership at 10th street and downstream of Somerville Road. A section of the creek between the AT&SF Railroad right-of-way and Somerville Road would be excavated to create a 600-foot-long by 200-foot-wide sedimentation basin. In the past, flood improvements, in the form of a widened, concrete-lined channel, were constructed in sections of West Antioch Creek, within the project reach.

Earth Channel and Flood Channel

Under this alternative, the project design parallels that of the Earth Channel and Sedimentation Basin alternative except a 1,500-foot-long by about 50-foot-wide drainage channel, extending from the AT&SF Railroad to the San Joaquin River, would be constructed in lieu of the sedimentation basin. The 600 feet of West Antioch Creek south of the AT&SF Railroad would be enlarged to a 90-foot wide, earthen channel with a service road.

BIOLOGICAL RESOURCES

Vegetation

Vegetation north of the AT&SF Railroad is composed of emergent brackish marsh and a dense stand of willows. The habitat is highly productive and provides critical nesting, feeding and nursery habitat for wildlife. Additionally, the proximity of differing habitat types to each other increases substantially to the overall value of the area to wildlife by creating a mosaic of habitat type and providing large areas of "edge" habitat. The vegetation contributes to adjacent aquatic habitat by providing food, shelter, and valuable nursery grounds to fish, and also nutrients to the aquatic food chain. The willow thicket is comprised primarily of arroyo willow and blackberry, while cattail, bulrush, sedge, pickleweed, salt grass, gumweed and brass button are the primary components of the brackish marsh habitat.

The proposed sedimentation basin site contains seasonal wetland and grassland vegetation. Several small willow/blackberry thickets along with cattail, sedge, bulrush and grasses dominate the basin site. Vegetation here is important to wildlife species because it provides "edge" habitat to the extensive nearby wetland habitat. The value of the seasonal wetland to wildlife is somewhat diminished by the presence of industrial developments and the AT&SF Railroad right-of-way. A stand of non-native mature trees (approximately 200 feet in length) along the west bank of the creek and north of Somerville Road, includes redwood, eucalyptus, black walnut, and Monterey pine. The canopy is important to wildlife in that it provides crucial nesting area, shelter, and a natural migration corridor.

Existing upland habitat between 6th Street and Somerville Road has limited value to wildlife since the land is maintained for industrial development. The area is periodically disced to remove vegetation. Consequently, wildlife occurrence and use of the habitat is reduced.

The upper reach of the creek, south of Somerville Road, is fringed primarily with ruderal plants. Blackberry vines, cattails, sedges, bulrushes, and a few, small willows and fruit trees can be found along the creek bank and channel. Annual grasses and forbs fringing the creek include wild oat, wild mustard, wild radish, filaree, dock and plantain. The periodic dredging of the creek and the accumulation of urban refuse in the creek have degraded much of the creek's vegetative values.

Riparian vegetation at the mouth of Marklee Creek is dense, of good quality, and provides important habitat to wildlife. Wildlife occurrence at the creek, though, is likely affected by the Southern Pacific (SP) Railroad and residential development adjacent to Marklee Creek.

Fisheries

Fish occurrence and distribution at the project area is nearly confined to the aquatic/marsh habitat north of the AT&SF Railroad right-of-way. The emergent vegetation provides important spawning and nursery habitat and feeding grounds to a number of fish species. The Sacramento-San Joaquin Delta system, of which this project is an integral part, supports anadromous striped bass, steelhead trout and chinook salmon, American shad and sturgeons. Additionally, warmwater game fish such as largemouth bass, catfish, sunfish, and crappie along with numerous non-game fish species are commonly found in these waters. Past records indicate anadromous steelhead and resident rainbow trout were found to inhabit a number of streams in the region. Recent investigations, however, indicate anadromous salmonid use of West Antioch Creek is unlikely. Past and present land-use practices in the watershed, coupled with urbanization along the creek, has severely degraded stream habitat quality, making its use by salmonids unlikely. However, it is possible for the West Antioch Creek watershed to support anadromous lamprey, since the muddy/silty conditions in the creek does provide usable habitat for their young. Adult lamprey enter and spawn in coastal streams during high winter flows. Later in the spring, soon after the eggs have hatched, the young lamprey burrow into the mud, where they feed on detritus and algae. Small resident fish species may also inhabit sections of the creek in and adjacent to the project area.

Contra Costa County, through its mosquito abatement program, introduced mosquitofish into West Antioch Creek as an eradication measure to reduce mosquito larvae. Apparently, the fish do tolerate and survive the poor water conditions in the creek.

Wildlife

Vegetation in the West Antioch Creek drainage provides valuable habitat to a diverse assemblage of wildlife. Small mammals common to the region include raccoon, skunk, opossom, rabbit, hare, ground squirrels and other rodents. The creek serves as an important migratory corridor through the

urban area, and provides access to the aquatic and marsh habitat for small animals. Vegetation throughout the project site offers food and cover to mammals. The open upland habitat supports an extensive colony of ground squirrels and other small rodents. Various reptile and amphibian species also frequent creekside vegetation and the aquatic/marsh environment.

A vast number of migratory and resident birds frequent the region. Passerine birds, including long-billed marsh wren, common yellow throat, red-winged blackbird, rufus-sided towhee and sparrows, and upland gamebirds such as California quail, nest in emergent and riparian vegetation found throughout the project area. Great blue heron and great egret feed extensively in the marsh environment. American bitterns use emergent vegetation for cover and may breed in the more secluded section of the marsh. Local habitat provides year-round nesting, feeding, and resting grounds for Pacific Flyway waterfowl and other migratory birds and resident shorebirds. American coot, northern and cinnamon teals, western grebe, double-crested cormorant, terns, rails, stilt, dowitcher, and avocet are a few of the many birds shown to occur in the ecoregion (FWS Special Study, 1987). Raptors such as kites, hawks and owls likely hunt for food on lands in the project area.

Endangered Species

According to our endangered species staff, the following list of listed and proposed endangered and threatened species and candidate species may occur in the area of the proposed project:

Listed Species

salt marsh harvest mouse, *Reithrodontomys raviventris*

Proposed Species

None

Candidate Species

California black rail, *Laterallus jamaicensis caturniculus* (2)
curved-foot hygrotus beetle, *Hygrotus curvipes* (2)
Antioch andrenid bee, *Perdita scituta anthiochensis* (2)
yellow-banded andrenid bee, *Perdita hirticeps luteocincta* (2)
an unnamed land snail, *Helminthoglypta nickliniana bridgesi* (2)
Suisun aster, *Aster chilensis* var. *lentus* (2)
soft bird's beak, *Cordylanthus mollis* subsp. *mollis* (1)
Delta tule pea, *Lathyrus jepsonii* subsp. *jepsonii* (2)
Mason's lilaeopsis, *Lilaeopsis masonii* (2)

(1)--Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.

(2)--Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposal rule is lacking.

IMPACTS OF THE ALTERNATIVES

No Project Alternative

Under this alternative, no change will occur.

Earth Channel and Sedimentation Basin

Constructing the sedimentation basin would require removal of about three acres of seasonal wetland and grassland vegetation. The loss of about 3/4 acre of vegetation, including a stand of assorted, non-native mature trees, would occur from the construction of a concrete channel north of Somerville Road. About three and one-half acres of upland habitat would be removed during stream channel realignment between Somerville Road and 6th Street. Habitat losses incurred from channel improvements to Marklee Creek would require the removal of 1,500 square feet of riparian vegetation. Additionally, approximately two miles of creekside vegetation would be removed with this alternative. These habitat losses would substantially reduce existing feeding, nesting and resting grounds and shelter available to wildlife in the area. The reduction in carrying capacity of the ecoregion would adversely impact a wide variety of songbirds, small mammals,as well as raptors, migratory birds, reptiles and amphibians. Widening of the creek would lower the water depth by increasing the surface area of the creek bottom. This would adversely affect fish migration through the area, and would remove a large area of the creek from the benefits of riparian cover. Additionally, clearing the creek of all substrate to form a smooth channel would severely reduce and alter aquatic invertebrate diversity and their numbers.

Earth Channel and Flood Channel

Under this alternative, losses incurred through project implementation would total about six acres of marsh and riparian wetlands and upland habitat. The impacts of removing the dense stand of riparian growth at the mouth of Marklee Creek, the stand of non-native trees, a section of the open upland area and about two miles of creekside vegetation would be similar to those discussed under the Earth Channel and Sedimentation Basin. Habitat losses incurred from removing a 1,500-foot by 50-foot swath of emergent and riparian vegetation north of the AT&SF Railroad would have the greatest adverse environmental consequences of all project-related impacts. A reduction in habitat quantity and quality would not only have a negative effect upon wildlife occurrence and diversity, but on fish resources as well. Such actions would bring about a significant reduction in food, shelter, nesting and nursery habitat available to fish and wildlife in the ecoregion.

biotechnical bank stabilization of the channel banks, revegetation of the channel periphery with native riparian vegetation and a low-flow channel.

A revegetation plan for the project should be implemented. The goal should be to create a canopy of trees with an understory of shrubs and ground coverage consisting of grasses and forbes at the affected areas. Plants should include only native, herbaceous and woody species from potted, nursery stock. Revegetation of the affected areas should be done during the late winter, unless the plant species require otherwise. Where plants may cause structural damage to the channel, root-control structures should be used to direct the plants roots downward. Additionally, all revegetated sites should receive frequent irrigation to ensure proper growth. This can be accomplished by constructing drip or overhead irrigation systems, or watering the new plants by truck from the service road. We recommend that biotechnical bank stabilization, using willow mats, be added to all earth banks along the channel and basin. Biotechnical bank protection not only protects earth banks from erosion, but also provide fish and wildlife habitat during the interim maturation period for bank vegetation.

Finally, a long-term, vegetation management plan should be developed to insure the effectiveness of the biotechnical bank stabilization and survival of the revegetated sites. Criteria should be established for the periodic monitoring and necessary maintenance of channel bank vegetation. The completed revegetation plan should be approved by the Fish and Wildlife Service and California Department of Fish and Game.

A stream survey of West Antioch and Marklee Creeks is recommended to determine if migratory and/or resident fish inhabit the streams. The results of the survey would provide information needed to determine the value of stream habitat lost from project construction. Timing of the survey is important and should correspond with the migration period for anadromous fish species inhabiting other streams in the region. Fish sampling techniques may include backpack electroshocker, fyke net and live box, seines and/or visual observation. Several locations throughout the two streams should be sampled to insure more accurate evaluation.

CONCLUSION

To avoid any adverse project effects on valuable riparian and emergent vegetation in West Antioch and Marklee Creeks and the marsh, we recommend selection of the No Project alternative. Additionally, to greatly reduce negative impacts of the two structural alternatives on the resources, we recommend that they be modified and any occurring adverse impacts be mitigated as follows:

1. Earth Channel and Sedimentation Basin - The project include a revegetation program directed at establishing native trees, shrubs, grasses and forbs on the newly constructed channel and basin banks. The goal of the plan is to create and maintain a naturally functioning wetland ecosystem typical to the unaltered Delta. Also, biotechnical bank stabilization techniques that incorporate willow mats and willow plantings should be included in the project designs.

2. Earth Channel and Flood Channel - A flood channel to the San Joaquin River should not be built. Instead, an alternate flood channel route should be constructed around or across the southwest corner of the marsh. Also, construction of the Earth Channel and Sedimentation Basin would have fewer impacts on the local environment than would the flood channel alternative. All flood channel alternatives should include environmental impacts and compensation requirements for each. Therefore, we will conduct a Habitat Evaluation Procedure to identify project impacts and measures required to mitigate adverse impacts. Additionally, a revegetation program as described in the Earth Channel and Sedimentation Basin alternative be included in each of the alternatives.

Six to seven acres of riparian/marsh vegetation and upland habitat will be impacted by the Earth Channel-Sedimentation Basin and Earth Channel-Flood Channel alternatives, respectively, and about two miles of creekside ruderal vegetation would be destroyed by the Earth Channel-Sedimentation Basin alternative. However, the value of habitat lost with the Earth Channel and Flood Channel would have greater adverse impacts on fish and wildlife resources than with the Earth Channel-Sedimentation Basin alternative. Long-term fish and wildlife impacts would continue due to ongoing channel maintenance under both alternatives. A survey of West Antioch and Marklee creeks is recommended prior to any channel improvements. The survey results would help to assess the value of stream habitat lost through project construction and would assist in determining appropriate compensation for lost creek habitat.

Several listed and proposed endangered and threatened species and candidate species may occur in the proposed project area. For information regarding survey methodology for these species, please contact Mr. Jack Williams at FTS 460-4866.

We appreciate the opportunity to provide input to your planning process. For further assistance regarding this letter, please contact Al Jensen of my staff at (FTS) 460-4613 or (916) 978-4613.

Sincerely,

James J. McKevitt
Field Supervisor

cc: Reg. Dir., AFWE, FWS, Portland, OR
SESO, FWS, Sacramento, CA
Reg. Mgr., Reg. II, CDFG, Rancho Cordova

REFERENCES

1. California Department of Fish and Game. 1987. Personal Communication with John Emig, Region III, Yountville, California.

2. U.S. Fish and Wildlife Service. 1987. Venice Cut and Donlon Island Marsh Creation Project.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
SACRAMENTO ENDANGERED SPECIES OFFICE
2800 Cottage Way, Room E-1823
Sacramento, California 95825-1846

AUG 2 7 1987

In Reply Refer To:
JW/1-1-87-SP-555

Mr. Walter Yep, Chief
Planning Division
U.S. Army Corps of Engineers
650 Capitol Mall
Sacramento, California 95814-4794

Subject: Proposed Flood Protection along West Antioch Creek, Contra Costa County

Dear Mr. Yep:

As requested by letter from your agency dated July 22, 1987, you will find attached a list of listed endangered and threatened species (Attachment A) that may be present in the area of the subject project. To the best of our knowledge no proposed species occur within the area. The list is intended to fulfill the requirement of the Fish and Wildlife Service to provide a list of species under Section 7(c) of the Endangered Species Act, as amended. Please see Attachment B for your requirements.

Also for your assistance, we have included a list of candidate species. These species are presently being reviewed by our Service for consideration to propose and list as endangered or threatened. Candidate species have no protection under the Endangered Species Act and are included for your consideration as it is possible the candidates could become formal proposals and be listed during the construction period.

Upon completion of the Biological Assessment (see Attachment B), should you determine that a listed species is likely to be affected (adversely or beneficially), then your agency should request formal Section 7 consultation through our office at the letterhead address. If there are both listed and candidate species (if included in the assessment) that may be affected and if requested, we will informally consult on the candidate species during the formal consultation. However, should the assessment reveal that only candidate species may be affected, then you should consider informal consultation with our office at the letterhead address.

00290

ATTACHMENT B

One of the benefits of informal consultation to the consulting agency is to provide the necessary planning alternatives should a candidate species become listed before completion of a project. Informal consultation may also be utilized prior to a written request for formal consultation to exchange information and resolve conflicts with respect to listed species.

If the Biological Assessment is not initiated within 90 days of receipt of this letter, you should informally verify the accuracy of the list with our office.

Should you have any additional questions regarding this list or your responsibilities under the Act, please contact Dr. Jack Williams at (916) 978-4866 or (FTS) 460-4866. Thank you for your interest in endangered species, and we await your assessment.

Sincerely,

Gail C. Kobetich

Gail C. Kobetich
Field Supervisor

Attachments

cc: Chief, Endangered Species, Portland, Oregon (FWE-SE; Attn: Ralph Swanson)
Field Supervisor, Ecological Services, Sacramento, California (ES-S; Attn: Al Jensen)

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CANDIDATE SPECIES THAT MAY OCCUR IN THE AREA OF THE PROPOSED WEST ANTIOCH CREEK: REACHES A AND B
(Case No. 1-1-87-SP-555)

Listed Species

Mammals

Salt marsh harvest mouse, Reithrodontomys raviventris (E)
(reach A and perhaps downstream 1/4 of reach B)

Proposed Species

None

Candidate Species

Birds

California black rail, Laterallus jamaicensis coturniculus (2)
(reach A only)

Invertebrates

Curved-foot hygrotus beetle, Hygrotus curvipes (2)
(reach A only)
Antioch andrenid bee, Perdita scituta anthiochensis (2)
(reaches A and B)
Yellow-banded andrenid bee, Perdita hirticeps luteocincta (2)
(reaches A and B)
An unnamed land snail, Helminthoglypta nickliniana bridgesi (2)
(reach A only)

Plants (all reach A only)

Suisun aster, Aster chilensis var. lentus (2)
Soft bird's-beak, Cordylanthus mollis subsp. mollis (1)
Delta tule pea, Lathyrus jepsonii subsp. jepsonii (2)
Mason's lilaeopsis, Lilaeopsis masonii (2)

(E)--Endangered (T)--Threatened (CH)--Critical Habitat

(1)--Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.

(2)--Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

STATE OF CALIFORNIA—THE RESOURCES AGENCY
GEORGE DEUKMEJIAN, Governor

DEPARTMENT OF FISH AND GAME
POST OFFICE BOX 47
YOUNTVILLE, CALIFORNIA 94599
(707) 944-2011

August 27, 1987

Walter Yep
Planning Division
Department of The Army
Sacramento District Corps of Engineers
650 Capital Mall
Sacramento, CA 95814-4794

Dear Mr. Yep:

Our personnel have reviewed the Notice of Initiation of Investigation for Flood Control for West Antioch Creek in Contra Costa County. The purpose of the investigation is to determine the feasibility of Federal participation in the development and construction of flood control measures along West Antioch Creek. Our personnnel surveyed the creek from Highway 4 north to its outlet into the San Joaquin River. We have the following comments:

The creek has been previously channelized and culverted along the entire length surveyed. From Highway 4 north into the Glass Containers Company property there exists little vegetation in the channel and almost no shrubs or trees along the bank. Channel vegetation consists primarily of grass and scattered cattails. A heavier growth of cattails is located between the Contra Costa Fairgrounds and Sycamore Drive.

At the northern end of the Glass Containers Company property, the creek widens and vegetation has been allowed to grow. Thick pockets of cattails and willows exist. To the north of the railroad tracks, where the creek flows into the river, there is a very thick area of willows and cattails.

A sediment basin and outlet pond have been proposed on the Glass Containers property in order to benefit the marsh by reducing the amount of sediment that is discharged into the marsh from West Antioch Creek. We have concerns as to the need for this basin. If it can be shown that a heavy sediment load is entering the marsh as a direct result of upstream development, and is damaging the marsh, we would support some means of trapping and removing the excess silt. However, if the sediment flowing into the marsh is due to natural erosion, our position would be that a sediment basin is unnecessary and might actually cause damage to the continued natural development of the marsh. This Department does not have sufficient information regarding sediment flows to support either position at this time. Concern also has been expressed as to whether the sediment basin would actually reduce the amount of silt moving into the marsh. More information is needed on this subject as well.

The primary concerns of our Department regarding this project include loss of wildlife habitat and impacts to endangered species. Our position is that a project must not result in a loss of wetland acreage and wetland value. Although we are concerned with the entire length of the project, it is the most northerly section that has the highest wildlife value. This is the area where the proposed sediment basin and outlet ponds would be built. The benefits to the habitat from this construction should be shown to outweigh the losses to vegetation and wildlife that will be incurred. Mitigation to replace acreage and value must also be considered. Typical riparian mitigation supported by this Department includes 3:1 replacement of trees, maintenance of planted vegetation for 3 years and a guarantee of survival at the end of that time. If a section of the marsh is destroyed, an equal or greater amount of marshland would need to be created to replace acreage and value.

Although data are not available specifically for the project area, the California Natural Diversity Database indicates that several species of endangered plants and animals occur in its vicinity. Surveys would be needed to determine if any rare, threatened or endangered species occur on the project site. Adverse impacts and suitable mitigation could then be identified.

Department personnel are available to discuss our concerns in more detail. To arrange a meeting contact Terry Palmisano, Wildlife Biologist, at (415) 484-2586; or Theodore Wooster, Environmental Services Supervisor, at (707) 944-2011.

Sincerely,

Watson for Burkhead

Brian Hunter
Regional Director
Region 3

Drainage Area 55 – West Antioch Creek Channel Improvements Feasibility Study/Cost Considerations (May 2010)

Contra Costa County
Flood Control
& Water Conservation District

Memo to File

TO: File

DATE: May 13, 2010

FROM: Carl J. Roner, Associate Civil Engineer

SUBJECT: Cost Protection Considerations for DA55, West Antioch Creek

FILE: 3055-05

CHARGE TO WO #8399

The channel in West Antioch Creek upstream of Station 30+00 is inadequately sized for the flows received, and frequently floods the vicinity of 10th and O Streets. Construction of culverts and/or modifying the channel to increase capacity under 10th Street and the former Eames Ford Dealership property have been proposed as a potential solution for this flooding; however, the effectiveness of this solution from a cost perspective has not been considered. This memo summarizes the cost estimates for several different culvert configurations and then looks at the level of protection each of these configurations provides.

Background

In 1984, the Contra Costa County Flood Control and Water Conservation District (District) issued a draft Environmental Impact Report (EIR), including an Engineer's Report, for the West Antioch Creek Improvements. The Engineer's Report recommended improving the West Antioch Creek channel from its crossing with what was then the Southern Pacific Railroad, (now Union Pacific Railroad), downstream, to its confluence with the brackish marshes of the San Joaquin River. Recommended improvements consisted of concrete-lined channels, trapezoidal earthen channels, and box culverts along the stream's length. In 1985, the Board of Supervisors approved the EIR.

The Engineer's Report refers to Federal participation in the construction of the channel improvements. In response to the District seeking Federal aid, the Corps of Engineers, in August of 1988, issued their Reconnaissance Report, which concluded that the creek improvement was not economically feasible in terms of Federal participation.

In 1993, the District implemented a portion of the plan by constructing concrete-lined and earthen trapezoidal channel from near the creek's confluence with the San Joaquin River (Station 2+00) to Station 30+48 (approximately 600 feet north and west of 10th Street) with local funds. These improvements, with the exception of the Burlington Northern Santa Fe (BNSF) Railroad bridge, brought the channel to the ultimate

configuration. The BNSF bridge at Station 4+00 was also improved somewhat at this time; however, it remained an impediment to flow due to its limited span and resulting flow area. At this same time, the City of Antioch also replaced the 4th Street Bridge, providing adequate freeboard for the creek at this crossing.

In April 1997, the City of Antioch accepted maintenance responsibility for West Antioch Creek.

Subsequent to the 1993 improvements, West Antioch Creek has not been desilted and has accumulated several feet of sediment. Prior to any work upstream of the 1993 improvements, this accumulated sediment will have to be removed.

Upstream of the 1993 improvements, West Antioch Creek is conveyed in a small concrete-lined ditch up to 10th Street. The creek is conveyed under 10th Street in two 9.2 foot wide by 4.8 foot high structural plate steel arches, and upstream, through the fairgrounds, the creek flows in a narrow earthen channel.

Flooding, which affects the 10th and O Streets area on nearly an almost yearly basis, occurs at the inlet to two structural plate steel arches. These arches cannot convey even relatively small storm events under 10th Street. During these occurrences, water backs up behind the headwall, overtops the channel in the fairgrounds, flows over 10th Street, and floods the neighborhood downstream.

Further down the creek, near the intersection of 6th and O Streets, there is a vacant lot with a low area that allows water to flow eastward from the creek and up 6th Street, to the City's Corporation Yard. This low area extends all the way to M Street.

The 1984 draft EIR proposed replacement of the existing arch pipes under 10th Street and the concrete-lined ditch with four 14 feet wide by 7 foot high reinforced concrete box culverts. This solution still has merit, and the cost for it will be estimated as part of this memo.

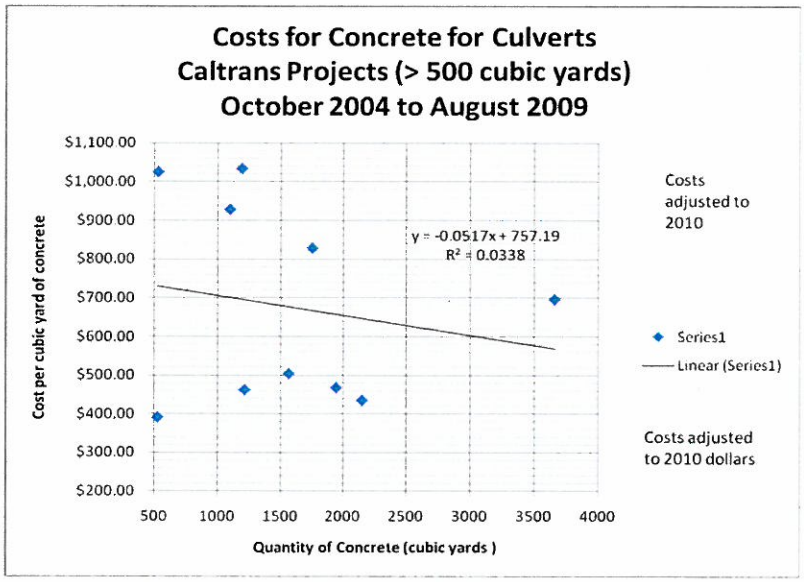
Culvert Cost Estimates

Due to the significant costs associated with both constructing a culvert conveyance and acquiring right of way for the culverts, and with the aim to optimize the culvert design, several different sizes of culvert besides the original four 14 foot by 7 foot reinforced concrete box culverts are evaluated as part of this assignment.

The cost estimates provided here are based Contra Costa County Public Works and Caltrans prices for similar projects. Of critical note from an estimating perspective, is the cost of culvert concrete and steel, which typically comprises of 70 to 75 percent of the construction estimate for the proposed improvements. As Contra Costa County Public Works has not recently constructed culverts, Caltrans cost data for box culverts and reinforcing steel was compiled from Construction Bidboard (http://www.ebidboard.com/) for the period of October 2004 through August 2009.

The top three bidder's costs for each Caltrans project were averaged and adjusted to 2010 costs based on the ENR Cost Indices, and then compared with the quantity of the material used on the specific project. A straight-line equation for concrete and steel costs compared with quantities of materials estimated was generated based on Caltrans data. For culvert concrete the equation was:

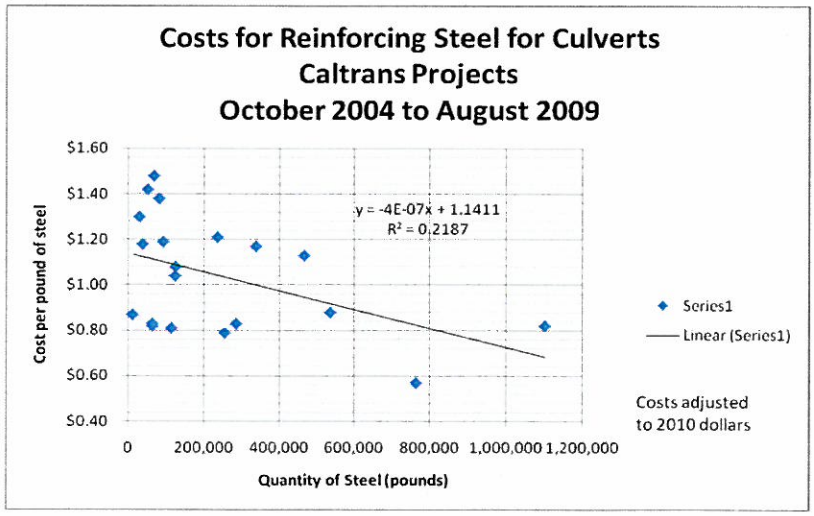
Cost per cubic yard of culvert concrete =
-$0.0517 * Quantity of Concrete (in cubic yards) + $757.19



Projects that used less than 500 cubic yards of concrete were not considered, and a minimum cost of $400/cubic yard was established regardless of the size of the job.

The equation for culvert reinforcing steel was:

Cost per pound of culvert steel = -$0.0007 * Quantity of steel (in pounds) + $1.14



For culvert reinforcing steel a minimum cost of $0.72/pound was used, regardless of the size of the job.

Caltrans has standard plans for culverts with spans up to 14 feet wide. These standard plans include quantities of steel and concrete per linear foot of culvert, aiding estimation efforts. Caltrans notes on the standard plans that culverts greater than 14 feet in span require special design. For purposes of this estimate, it is assumed that the amount of steel and concrete required by those culverts greater than 14 feet in width is proportional to the Caltrans culverts with lesser spans. It is also assumed that since culverts greater than 14 feet span require special design, a $75,000 surcharge should added to the Design Engineering costs for structural design.

The estimating data used for the concrete culverts assumes that they are cast-in-place. It is the District's understanding that precast culvert segments may offer a significant cost savings over cast–in-place culvert if a casting yard is local and if traffic issues associated with transporting the segments can be resolved.

All culverts estimated had a depth of 7 feet in order to match the creek's existing flowline. For initial estimating purposes, all culverts were assumed to span 10th Street plus the entire length of the creek through the Eames property, giving a length of 620 linear feet. Other culvert lengths are also examined in this memo.

Several other assumptions were made in the estimates:

- The top of the culvert will be exposed (not paved over) on the Eames property.
- 10th Street will be paved with 6 inches asphalt concrete with 16 inches of aggregate base. It is likely that asphalt concrete may be applied directly to the box culverts, but the aggregate base will be included for the purposes of estimating.
- Those portions of the Eames property to be paved will have 4 inches of asphalt concrete with 6 inches of aggregate base.
- The estimates do not include any property acquisition costs. Acquisition costs for various alternatives are being considered and will be incorporated into this analysis at a later date.
- The estimates include a 20 percent contingency and a 10 percent construction engineering costs.
- The Eames site will be vacated and the contractor will be able to move around it at will.

Estimates for several culvert options are presented in the attachments and summarized in the following table:

Table 1
Cost Estimates for Culvert of Various Cross-Sections

Estimate Number	Culvert Size	Number of Culverts	Caltrans Standard (Yes/No?)	Culvert Flow Area	Estimated Culvert Cost (million dollars)
1	8′ x 7′	2	Yes	112	3.35
2	Two 12′ x 7′ and One 8′ x 7′	3	Yes	224	5.15
3	12′ x 7′	2	Yes	168	3.80
4	12′ x 7′	3	Yes	252	5.17
5	12′ x 7′	4	Yes	336	6.58
6	14′ x 7′	2	Yes	196	4.03
7	14′ x 7′	3	Yes	294	5.51
8	14′ x 7′	4	Yes	392	6.99
9	Four 14′ x 7′ and One 8′ x 7′	5	Yes	448	7.76
10	16′ x 7′	1	No	112	3.67
11	16′ x 7′	2	No	224	5.39
12	16′ x 7′	3	No	336	6.72
13	16′ x 7′	4	No	448	7.91

From the cost estimates, it can be seen that using non-Caltrans sized culverts will increase the cost for the project due to increased design and concrete costs.

Culvert Performance

Several of the culverts that had their costs estimated above were modeled in HEC-RAS to determine potential performance under specific frequency storms. The culverts are compared here to see which provided the best flood protection for the estimated cost. The level of protection provided for each option is the largest frequency of storm that doesn't overtop 10th Street. The HEC-RAS model assumed that the existing channel downstream of Station 30+48 to the San Joaquin River was desilted and in the as-built condition. Several additional conditions were also modeled independently to explore the benefits of an expanded project. These additional conditions (or "upgrades") were:

- The ultimate channel was constructed through the Contra Costa County Fairgrounds (Stations 40+00 to 37+00). The estimated cost for removing approximately 75,000 cubic yards and placing it on adjacent fairground property is $150,000.
- The BNSF Railroad bridge at Station 4+02 has an additional 14-foot bent added to it, expanding its creek cross-section. An estimate was not available for this modification.
- The BNSF Railroad bridge at Station 4+02 has two additional 14-foot bents added to it, expanding its creek cross-section. An estimate was also not available for this modification.

Table 2 shows a comparison of the culvert performance with estimated culvert cost.

Conclusions

One factor that also became readily apparent in the modeling of the creek is that culverts by themselves will not be able to provide the higher levels of flood protection for the 10th Street area. Specifically, there may be a diminishing return associated with installing additional culverts. Other improvements, such as widening the channel at the BNSF Bridge, may have to be implemented to achieve higher flood protection levels. In particular, there is a low area near 6th Street that would benefit from the reduced water levels that widening the BNSF Bridge would provide.

As can be seen, the cost for even nominal protection for the 10th Street area is high. This high cost for the culverts is attributable to the large amount of concrete and steel required for the construction of 620 feet of culvert. These two components alone make up about 75 percent of the overall project construction costs. Costs for culverts may be reduced if a precast yard that can construct these sections is located locally.

In the past, maintaining the full integrity of the Eames property for auto sales purposes was a primary consideration. Using part of the Eames property for an open channel was not considered previously. Currently, with the reduction nationally of car dealerships, the likelihood that this property will be used for a new car dealership is limited. Considering that the cost of property is perhaps lower than the cost of extended concrete culverts, improved protection may be found for less cost if some of the former Eames Ford Dealership is turned into open channel. This also has environmental benefits as well by limiting the length of culvert work. What remains of the Eames property would be useable for other types of businesses or high-density residential.

To explore the option shortening the channels, a HEC-RAS model was run with the culvert length reduced from 620 feet to 402 feet. The remaining 218 feet of the channel was modeled to match the as-built channel downstream. This option would cost $3.95 million, and Estimate Number 14 shows a breakdown of the costs. The results of this option are also shown in Table 2 for comparison with the longer culvert options. As can be seen, reducing the culvert length reduces the project construction costs significantly. It also provides significantly more flood protection than does a longer culvert of any size.

For the shortened culvert length, approximately 10,600 square feet on the downstream side (north edge) of the former Eames Ford Dealership property, including some buildings, would be used to form the open channel area. This northern corner of the Eames property does not have frontage on 10th or O Streets and access to it is limited. Its' value is expected to be less than the southern and eastern sides of the property. Depending on the current worth of this portion of the Eames property, using this area for open channel may be a much more cost-effective alternative than constructing full-

length culverts. A detailed right of way analysis is being prepared and will be incorporated into this analysis at a later date.

Recommendations

To provide the most economical flood protection, the following projects should be implemented in order:

1. Desilt existing improved channel from Station 2+00 to Station 30+48
2. Construct four 14 x 7 foot culverts, 402 feet long, from 10th Street, downstream, and 228 feet of open channel, connecting the 1993 improvements to the fairgrounds. Two or three culverts may be constructed first as funding allows. One 14 x 7 culvert only offers 29 percent greater flow area than the existing culverts under 10th Street, and thus may not offer much of an improvement to local flooding.
3. Widen the BNSF bridge by at least an additional bent (14 feet).
4. Construct the ultimate channel (as specified by the 1984 Engineer's Report) upstream of 10th Street. This work does not have to be implemented until the fairgrounds are redeveloped; channel improvements should be conditioned as part of the developer's entitlement.

CJR
G:\fldctl\Watershed Planning - Engineering\DA 55 - West Antioch Creek\10th Street Culvert\Memo to File 5-13-2010.doc
Attachments
Cc: Paul Detjens

Table 2
Cost-Protection Matrix for West Antioch Creek at 10th Street

Culverts across 10th Street and Eames Property

	Culvert Size	Four 14' x 7' (402' long)	Two 16' x 7' (620' long)	Three 14' x 7' (620' long)	Four 12' x 7' (620' long)	Three 16' x 7' (620' long)	Four 14' x 7' (620' long)	Four 16' x 7' (620' long)
	Culvert Area (square feet)	392	224	294	336	336	392	448
	Estimated Culvert Cost	$3.95 million**	$5.39 million	$5.51 million	$6.58 million	$6.72 million	$6.99 million	$7.91 million
	Estimate Number	14	11	7	5	12	8	13
A	Protection Provided with Culverts Plus As-Built Conditions Downstream	75-year protection	20-year protection	25-year protection	30-year protection	30-year protection	30-year protection	35-year protection
	Upgrades							
B	Protection Provided with (A) Plus Excavation of Upstream Channel to Ultimate Size	80-year protection	20-year protection	25-year protection	30-year protection	30-year protection	30-year protection	30-year protection
C	Protection Provided with (A) Plus Excavation of Upstream Channel and Addition of One Bent to BNSF Bridge*	100-year protection	20-year protection	30-year protection	35-year protection	40-year protection	45-year protection	40-year protection
D	Protection Provided with (A) Plus Excavation of Upstream Channel and Addition of Two Bents to BNSF Bridge*	Not Analyzed	Not Analyzed	35-year protection	Not Analyzed	Not Analyzed	50-year protection	45-year protection

*Costs for excavating the upstream channel to its ultimate configuration and the additions of bents to the BNSF Bridge are not included in the estimated culvert cost.

** Costs for 402' long culvert include costs for 218' of open channel

Contra Costa County Flood Control & Water Conservation District

Estimate No. 1

Flood Control Engineering | Preliminary Cost Estimate

Project Name: West Antioch Creek at 10th Street

Project Number: WO# 8399

Project Description: Phased Installation of Reinforced Concrete Box Culverts -- Two 8' x 7' Caltrans Standard Box Culverts, 620' long

Estimate Date: 19-Apr-10

Project Location: 10th and O Streets, Antioch, CA

Revision No.

Prepared by: Carl J. Roner

Revision Date:

Equivalent to One 16' x 7' Nonstandard Box Culvert

Est. Const. Year: 2010

No.	Description	Quantity	Units	Unit Cost	Total
1	Prepare Water Pollution Control Program	L.S.	1	$ 5,000	$ 5,000
2	Water Pollution Control Program	L.S.	1	$ 10,000	$ 10,000
3	Water Control	L.S.	1	$ 50,000	$ 50,000
4	Temporary Fence	L.F.	1,400	$ 16	$ 22,400
5	Clearing and Grubbing	L.S.	1	$ 50,000	$ 50,000
6	Traffic Control	L.S.	1	$ 8,000	$ 8,000
7	Mobilization	L.S.	1	$ 25,000	$ 25,000
8	Construction Area Signs	L.S.	1	$ 3,000	$ 3,000
9	Wing Walls	EA	2	$ 20,000	$ 40,000
10	Rip Rap Protection (1/4 Ton Rock, 25' downstream)	Tons	150	$ 130	$ 19,500
11	Fine Grading at Transition	EA	2	$ 5,000	$ 10,000
12	Utility Relocation	L.S.	1	$ 50,000	$ 50,000
13	Remove and Reconstruct Car Port	L.S.	1	$ 25,000	$ 25,000
14	Channel Excavation	C.Y.	4,410	$ 60	$ 264,600
15	Culvert Concrete	C.Y.	1,672	$ 670	$ 1,120,240
16	Culvert Steel	Pounds	434,000	$ 0.97	$ 420,980
17	Minor Concrete (Sidewalk)	S.F.	320	$ 10	$ 3,200
18	Minor Concrete (S1-6 Curb)	L.F.	128	$ 35	$ 4,480
19	Minor Concrete (Median)	S.F.	64	$ 10	$ 640
20	Asphalt Concrete (Street, 6" section, 16" AB included)	Tons	82	$ 170	$ 13,940
21	Asphalt Concrete (Parking Lot, 4" section, 6" AB)	Tons	201	$ 140	$ 28,140

OTHER COSTS:

Design Engineering	$ 525,000	Construction Subtotal	$ 2,174,120
Construction Engineering (10% of Construction Contract)	$ 217,412	Construction Escalation (0% due to current recession.)	$ 2,174,120
Geotechnical Report	$ -		
Real Property Labor	$ -	OTHER COSTS	$ 742,412
R/W Acquisition (Excluded from Contringency)	$ -	SUBTOTAL	$ 2,916,532
Environmental (Included in the overall project costs.)	$ -	CONTINGENCY [1]	$ 434,824
Total OTHER COSTS	$ 742,412	TOTAL	$ 3,351,356

[1] CONTINGENCY is 20% of Construction Subtotal

See attached sheets for additional assumptions and calculations.

Does not include environmental investigation and remediation

ROUNDED TOTAL $ 3,352,000

Contra Costa County Flood Control & Water Conservation District

Estimate No. 2

Flood Control Engineering — Preliminary Cost Estimate

Project Name: West Antioch Creek at 10th Street

Project Number: WO# 8399

Project Description: Phased Installation of Reinforced Concrete Box Culverts -- **Two 12' x 7' and One 8' x 7' Caltrans Standard Box Culverts, 620' long**

Estimate Date: 19-Apr-10

Project Location: 10th and O Streets, Antioch, CA

Revision No.

Prepared by: Carl J. Roner

Revision Date:

Equivalent to Two 16' x 7' Nonstandard Box Culverts

Est. Const. Year: 2010

No.	Description	Quantity	Units	Unit Cost	Total
1	Prepare Water Pollution Control Program	L.S.	1	$ 5,000	$ 5,000
2	Water Pollution Control Program	L.S.	1	$ 10,000	$ 10,000
3	Water Control	L.S.	1	$ 50,000	$ 50,000
4	Temporary Fence	L.F.	1,400	$ 16	$ 22,400
5	Clearing and Grubbing	L.S.	1	$ 50,000	$ 50,000
6	Traffic Control	L.S.	1	$ 8,000	$ 8,000
7	Mobilization	L.S.	1	$ 25,000	$ 25,000
8	Construction Area Signs	L.S.	1	$ 3,000	$ 3,000
9	Wing Walls	EA	2	$ 20,000	$ 40,000
10	Rip Rap Protection (1/4 Ton Rock, 25' downstream)	Tons	300	$ 130	$ 39,000
11	Fine Grading at Transition	EA	2	$ 5,000	$ 10,000
12	Utility Relocation	L.S.	1	$ 50,000	$ 50,000
13	Remove and Reconstruct Car Port	L.S.	1	$ 25,000	$ 25,000
14	Channel Excavation	C.Y.	7,350	$ 60	$ 441,000
15	Culvert Concrete	C.Y.	3,454	$ 580	$ 2,003,320
16	Culvert Steel	Pounds	915,120	$ 0.78	$ 713,794
17	Minor Concrete (Sidewalk)	S.F.	480	$ 10	$ 4,800
18	Minor Concrete (S1-6 Curb)	L.F.	192	$ 35	$ 6,720
19	Minor Concrete (Median)	S.F.	96	$ 10	$ 960
20	Asphalt Concrete (Street, 6" section, 16" AB included)	Tons	123	$ 170	$ 20,910
21	Asphalt Concrete (Parking Lot, 4" section, 6" AB)	Tons	201	$ 140	$ 28,140

OTHER COSTS:

Design Engineering	$ 525,000	Construction Subtotal	$ 3,557,044
Construction Engineering (10% of Construction Contract)	$ 355,704	Construction Escalation (0% due to current recession.)	$ 3,557,044
Geotechnical Report	$ -		
Real Property Labor	$ -	OTHER COSTS	$ 880,704
R/W Acquisition (Excluded from Contringency)	$ -	SUBTOTAL	$ 4,437,748
Environmental (Included in the overall project costs.)	$ -	CONTINGENCY [1]	$ 711,409
Total OTHER COSTS	$ 880,704	TOTAL	$ 5,149,157

[1] CONTINGENCY is 20% of Construction Subtotal

See attached sheets for additional assumptions and calculations.

Does not include environmental investigation and remediation

ROUNDED TOTAL $ 5,150,000

Contra Costa County Flood Control & Water Conservation District

Estimate No. 3

Flood Control Engineering — Preliminary Cost Estimate

Project Name: West Antioch Creek at 10th Street

Project Number: WO# 8399

Project Description: Phased Installation of Reinforced Concrete Box Culverts -- **Two 12' x 7' Caltrans Standard Box Culverts, 620' long**

Estimate Date: 3-May-10

Project Location: 10th and O Streets, Antioch, CA

Revision No.

Prepared by: Carl J. Roner

Revision Date:

Est. Const. Year: 2010

No.	Description	Quantity	Units	Unit Cost	Total
1	Prepare Water Pollution Control Program	L.S.	1	$ 5,000	$ 5,000
2	Water Pollution Control Program	L.S.	1	$ 10,000	$ 10,000
3	Water Control	L.S.	1	$ 50,000	$ 50,000
4	Temporary Fence	L.F.	1,400	$ 16	$ 22,400
5	Clearing and Grubbing	L.S.	1	$ 50,000	$ 50,000
6	Traffic Control	L.S.	1	$ 8,000	$ 8,000
7	Mobilization	L.S.	1	$ 25,000	$ 25,000
8	Construction Area Signs	L.S.	1	$ 3,000	$ 3,000
9	Wing Walls	EA	2	$ 20,000	$ 40,000
10	Rip Rap Protection (1/4 Ton Rock, 25' downstream)	Tons	225	$ 130	$ 29,250
11	Fine Grading at Transition	EA	2	$ 5,000	$ 10,000
12	Utility Relocation	L.S.	1	$ 50,000	$ 50,000
13	Remove and Reconstruct Car Port	L.S.	1	$ 25,000	$ 25,000
14	Channel Excavation	C.Y.	5,879	$ 60	$ 352,740
15	Culvert Concrete	C.Y.	2,618	$ 490	$ 1,282,820
16	Culvert Steel	Pounds	698,120	$ 0.72	$ 502,646
17	Minor Concrete (Sidewalk)	S.F.	400	$ 10	$ 4,000
18	Minor Concrete (S1-6 Curb)	L.F.	160	$ 35	$ 5,600
19	Minor Concrete (Median)	S.F.	80	$ 10	$ 800
20	Asphalt Concrete (Street, 6" section, 16" AB included)	Tons	102	$ 170	$ 17,340
21	Asphalt Concrete (Parking Lot, 4" section, 6" AB)	Tons	201	$ 140	$ 28,140

OTHER COSTS:

Design Engineering	$ 525,000	Construction Subtotal	$ 2,521,736
Construction Engineering (10% of Construction Contract)	$ 252,174	Construction Escalation (0% due to current recession.)	$ 2,521,736
Geotechnical Report	$ -		
Real Property Labor	$ -	OTHER COSTS	$ 777,174
R/W Acquisition (Excluded from Contringency)	$ -	SUBTOTAL	$ 3,298,910
Environmental (Included in the overall project costs.)	$ -	CONTINGENCY [1]	$ 504,347
Total OTHER COSTS	$ 777,174	TOTAL	$ 3,803,257

[1] CONTINGENCY is 20% of Construction Subtotal

See attached sheets for additional assumptions and calculations.

Does not include environmental investigation and remediation

ROUNDED TOTAL $ 3,804,000

Contra Costa County Flood Control & Water Conservation District

Estimate No. 4

Flood Control Engineering — Preliminary Cost Estimate

Project Name: West Antioch Creek at 10th Street

Project Number: WO# 8399

Project Description: Phased Installation of Reinforced Concrete Box Culverts -- **Three 12' x 7' Caltrans Standard Box Culverts, 620' long**

Estimate Date: 3-May-10

Project Location: 10th and O Streets, Antioch, CA

Revision No.

Prepared by: Carl J. Roner

Revision Date:

Est. Const. Year: 2010

No.	Description	Quantity	Units	Unit Cost	Total
1	Prepare Water Pollution Control Program	L.S.	1	$ 5,000	$ 5,000
2	Water Pollution Control Program	L.S.	1	$ 10,000	$ 10,000
3	Water Control	L.S.	1	$ 50,000	$ 50,000
4	Temporary Fence	L.F.	1,400	$ 16	$ 22,400
5	Clearing and Grubbing	L.S.	1	$ 50,000	$ 50,000
6	Traffic Control	L.S.	1	$ 8,000	$ 8,000
7	Mobilization	L.S.	1	$ 25,000	$ 25,000
8	Construction Area Signs	L.S.	1	$ 3,000	$ 3,000
9	Wing Walls	EA	2	$ 20,000	$ 40,000
10	Rip Rap Protection (1/4 Ton Rock, 25' downstream)	Tons	338	$ 130	$ 43,940
11	Fine Grading at Transition	EA	2	$ 5,000	$ 10,000
12	Utility Relocation	L.S.	1	$ 50,000	$ 50,000
13	Remove and Reconstruct Car Port	L.S.	1	$ 25,000	$ 25,000
14	Channel Excavation	C.Y.	8,083	$ 60	$ 484,980
15	Culvert Concrete	C.Y.	3,926	$ 490	$ 1,923,740
16	Culvert Steel	Pounds	1,047,480	$ 0.72	$ 754,186
17	Minor Concrete (Sidewalk)	S.F.	520	$ 10	$ 5,200
18	Minor Concrete (S1-6 Curb)	L.F.	208	$ 35	$ 7,280
19	Minor Concrete (Median)	S.F.	104	$ 10	$ 1,040
20	Asphalt Concrete (Street, 6" section, 16" AB included)	Tons	132	$ 170	$ 22,440
21	Asphalt Concrete (Parking Lot, 4" section, 6" AB)	Tons	201	$ 140	$ 28,140

OTHER COSTS:

Design Engineering	$ 525,000	Construction Subtotal	$ 3,569,346
Construction Engineering (10% of Construction Contract)	$ 356,935	Construction Escalation (0% due to current recession.)	$ 3,569,346
Geotechnical Report	$ -		
Real Property Labor	$ -	OTHER COSTS	$ 881,935
R/W Acquisition (Excluded from Contringency)	$ -	SUBTOTAL	$ 4,451,280
Environmental (Included in the overall project costs.)	$ -	CONTINGENCY [1]	$ 713,869
Total OTHER COSTS	$ 881,935	TOTAL	$ 5,165,149

[1] CONTINGENCY is 20% of Construction Subtotal

See attached sheets for additional assumptions and calculations.

Does not include environmental investigation and remediation

ROUNDED TOTAL $ 5,166,000

Contra Costa County Flood Control & Water Conservation District

Estimate No. 5

Flood Control Engineering — Preliminary Cost Estimate

Project Name: West Antioch Creek at 10th Street

Project Number: WO# 8399

Project Description: Phased Installation of Reinforced Concrete Box Culverts -- **Four 12' x 7' Caltrans Standard Box Culverts, 620' long**

Estimate Date: 19-Apr-10

Project Location: 10th and O Streets, Antioch, CA

Revision No.

Equivalent to Three 16' x 7' Nonstandard Box Culverts

Prepared by: Carl J. Roner

Revision Date:

Est. Const. Year: 2010

No.	Description	Quantity	Units	Unit Cost	Total
1	Prepare Water Pollution Control Program	L.S.	1	$ 5,000	$ 5,000
2	Water Pollution Control Program	L.S.	1	$ 10,000	$ 10,000
3	Water Control	L.S.	1	$ 50,000	$ 50,000
4	Temporary Fence	L.F.	1,400	$ 16	$ 22,400
5	Clearing and Grubbing	L.S.	1	$ 50,000	$ 50,000
6	Traffic Control	L.S.	1	$ 8,000	$ 8,000
7	Mobilization	L.S.	1	$ 25,000	$ 25,000
8	Construction Area Signs	L.S.	1	$ 3,000	$ 3,000
9	Wing Walls	EA	2	$ 20,000	$ 40,000
10	Rip Rap Protection (1/4 Ton Rock, 25' downstream)	Tons	450	$ 130	$ 58,500
11	Fine Grading at Transition	EA	2	$ 5,000	$ 10,000
12	Utility Relocation	L.S.	1	$ 50,000	$ 50,000
13	Remove and Reconstruct Car Port	L.S.	1	$ 25,000	$ 25,000
14	Channel Excavation	C.Y.	10,929	$ 60	$ 655,740
15	Culvert Concrete	C.Y.	5,236	$ 490	$ 2,565,640
16	Culvert Steel	Pounds	1,396,240	$ 0.72	$ 1,005,293
17	Minor Concrete (Sidewalk)	S.F.	640	$ 10	$ 6,400
18	Minor Concrete (S1-6 Curb)	L.F.	256	$ 35	$ 8,960
19	Minor Concrete (Median)	S.F.	128	$ 10	$ 1,280
20	Asphalt Concrete (Street, 6" section, 16" AB included)	Tons	163	$ 170	$ 27,710
21	Asphalt Concrete (Parking Lot, 4" section, 6" AB)	Tons	201	$ 140	$ 28,140

OTHER COSTS:

Design Engineering	$ 525,000	Construction Subtotal	$ 4,656,063
Construction Engineering (10% of Construction Contract)	$ 465,606	Construction Escalation (0% due to current recession.)	$ 4,656,063
Geotechnical Report	$ -		
Real Property Labor	$ -	OTHER COSTS	$ 990,606
R/W Acquisition (Excluded from Contringency)	$ -	SUBTOTAL	$ 5,646,669
Environmental (Included in the overall project costs.)	$ -	CONTINGENCY [1]	$ 931,213
Total OTHER COSTS	$ 990,606	TOTAL	$ 6,577,882

[1] CONTINGENCY is 20% of Construction Subtotal

See attached sheets for additional assumptions and calculations.

Does not include environmental investigation and remediation

ROUNDED TOTAL $ 6,578,000

Contra Costa County Flood Control & Water Conservation District

Estimate No. 6

Flood Control Engineering — Preliminary Cost Estimate

Project Name: West Antioch Creek at 10th Street

Project Number: WO# 8399

Project Description: Phased Installation of Reinforced Concrete Box Culverts -- Two **14' x 7' . Caltrans Standard Box Culverts, 620' long**

Estimate Date: 4-May-10

Project Location: 10th and O Streets, Antioch, CA

Revision No.

Prepared by: Carl J. Roner

Revision Date:

Est. Const. Year: 2010

No.	Description	Quantity	Units	Unit Cost	Total
1	Prepare Water Pollution Control Program	L.S.	1	$ 5,000	$ 5,000
2	Water Pollution Control Program	L.S.	1	$ 10,000	$ 10,000
3	Water Control	L.S.	1	$ 50,000	$ 50,000
4	Temporary Fence	L.F.	1,400	$ 16	$ 22,400
5	Clearing and Grubbing	L.S.	1	$ 50,000	$ 50,000
6	Traffic Control	L.S.	1	$ 8,000	$ 8,000
7	Mobilization	L.S.	1	$ 25,000	$ 25,000
8	Construction Area Signs	L.S.	1	$ 3,000	$ 3,000
9	Wing Walls	EA	2	$ 20,000	$ 40,000
10	Rip Rap Protection (1/4 Ton Rock, 25' downstream)	Tons	263	$ 130	$ 34,190
11	Fine Grading at Transition	EA	2	$ 5,000	$ 10,000
12	Utility Relocation	L.S.	1	$ 50,000	$ 50,000
13	Remove and Reconstruct Car Port	L.S.	1	$ 25,000	$ 25,000
14	Channel Excavation	C.Y.	6,613	$ 60	$ 396,780
15	Culvert Concrete	C.Y.	3,298	$ 400	$ 1,319,200
16	Culvert Steel	Pounds	820,880	$ 0.72	$ 591,034
17	Minor Concrete (Sidewalk)	S.F.	440	$ 10	$ 4,400
18	Minor Concrete (S1-6 Curb)	L.F.	176	$ 35	$ 6,160
19	Minor Concrete (Median)	S.F.	88	$ 10	$ 880
20	Asphalt Concrete (Street, 6" section, 16" AB included)	Tons	117	$ 170	$ 19,890
21	Asphalt Concrete (Parking Lot, 4" section, 6" AB)	Tons	201	$ 140	$ 28,140

OTHER COSTS:

Design Engineering	$ 525,000	Construction Subtotal	$ 2,699,074
Construction Engineering (10% of Construction Contract)	$ 269,907	Construction Escalation (0% due to current recession.)	$ 2,699,074
Geotechnical Report	$ -		
Real Property Labor	$ -	OTHER COSTS	$ 794,907
R/W Acquisition (Excluded from Contringency)	$ -	SUBTOTAL	$ 3,493,981
Environmental (Included in the overall project costs.)	$ -	CONTINGENCY [1]	$ 539,815
Total OTHER COSTS	$ 794,907	TOTAL	$ 4,033,796

[1] CONTINGENCY is 20% of Construction Subtotal

See attached sheets for additional assumptions and calculations.

Does not include environmental investigation and remediation

ROUNDED TOTAL $ 4,034,000

Contra Costa County Flood Control & Water Conservation District

Estimate No. 7

Flood Control Engineering — Preliminary Cost Estimate

Project Name: West Antioch Creek at 10th Street

Project Number: WO# 8399

Project Description: Phased Installation of Reinforced Concrete Box Culverts -- Three **14' x 7' . Caltrans Standard Box Culverts, 620' long**

Estimate Date: 3-May-10

Project Location: 10th and O Streets, Antioch, CA

Revision No.

Prepared by: Carl J. Roner

Revision Date:

Est. Const. Year: 2010

No.	Description	Quantity	Units	Unit Cost	Total
1	Prepare Water Pollution Control Program	L.S.	1	$ 5,000	$ 5,000
2	Water Pollution Control Program	L.S.	1	$ 10,000	$ 10,000
3	Water Control	L.S.	1	$ 50,000	$ 50,000
4	Temporary Fence	L.F.	1,400	$ 16	$ 22,400
5	Clearing and Grubbing	L.S.	1	$ 50,000	$ 50,000
6	Traffic Control	L.S.	1	$ 8,000	$ 8,000
7	Mobilization	L.S.	1	$ 25,000	$ 25,000
8	Construction Area Signs	L.S.	1	$ 3,000	$ 3,000
9	Wing Walls	EA	2	$ 20,000	$ 40,000
10	Rip Rap Protection (1/4 Ton Rock, 25' downstream)	Tons	394	$ 130	$ 51,220
11	Fine Grading at Transition	EA	2	$ 5,000	$ 10,000
12	Utility Relocation	L.S.	1	$ 50,000	$ 50,000
13	Remove and Reconstruct Car Port	L.S.	1	$ 25,000	$ 25,000
14	Channel Excavation	C.Y.	9,185	$ 60	$ 551,100
15	Culvert Concrete	C.Y.	4,947	$ 400	$ 1,978,800
16	Culvert Steel	Pounds	1,231,320	$ 0.72	$ 886,550
17	Minor Concrete (Sidewalk)	S.F.	580	$ 10	$ 5,800
18	Minor Concrete (S1-6 Curb)	L.F.	232	$ 35	$ 8,120
19	Minor Concrete (Median)	S.F.	116	$ 10	$ 1,160
20	Asphalt Concrete (Street, 6" section, 16" AB included)	Tons	147	$ 170	$ 24,990
21	Asphalt Concrete (Parking Lot, 4" section, 6" AB)	Tons	201	$ 140	$ 28,140

OTHER COSTS:

Design Engineering	$ 525,000	Construction Subtotal	$ 3,834,280
Construction Engineering (10% of Construction Contract)	$ 383,428	Construction Escalation (0% due to current recession.)	$ 3,834,280
Geotechnical Report	$ -		
Real Property Labor	$ -	OTHER COSTS	$ 908,428
R/W Acquisition (Excluded from Contringency)	$ -	SUBTOTAL	$ 4,742,708
Environmental (Included in the overall project costs.)	$ -	CONTINGENCY [1]	$ 766,856
Total OTHER COSTS	$ 908,428	TOTAL	$ 5,509,565

[1] CONTINGENCY is 20% of Construction Subtotal

See attached sheets for additional assumptions and calculations.

Does not include environmental investigation and remediation

ROUNDED TOTAL $ 5,510,000

Contra Costa County Flood Control & Water Conservation District

Estimate No. 8

Flood Control Engineering — Preliminary Cost Estimate

Project Name: West Antioch Creek at 10th Street

Project Number: WO# 8399

Project Description: Phased Installation of Reinforced Concrete Box Culverts -- **Four 14' x 7' . Caltrans Standard Box Culverts, 620' long**

Estimate Date: 3-May-10

Project Location: 10th and O Streets, Antioch, CA

Revision No.

Prepared by: Carl J. Roner

Revision Date:

Est. Const. Year: 2010

No.	Description	Quantity	Units	Unit Cost	Total
1	Prepare Water Pollution Control Program	L.S.	1	$ 5,000	$ 5,000
2	Water Pollution Control Program	L.S.	1	$ 10,000	$ 10,000
3	Water Control	L.S.	1	$ 50,000	$ 50,000
4	Temporary Fence	L.F.	1,400	$ 16	$ 22,400
5	Clearing and Grubbing	L.S.	1	$ 50,000	$ 50,000
6	Traffic Control	L.S.	1	$ 8,000	$ 8,000
7	Mobilization	L.S.	1	$ 25,000	$ 25,000
8	Construction Area Signs	L.S.	1	$ 3,000	$ 3,000
9	Wing Walls	EA	2	$ 20,000	$ 40,000
10	Rip Rap Protection (1/4 Ton Rock, 25' downstream)	Tons	525	$ 130	$ 68,250
11	Fine Grading at Transition	EA	2	$ 5,000	$ 10,000
12	Utility Relocation	L.S.	1	$ 50,000	$ 50,000
13	Remove and Reconstruct Car Port	L.S.	1	$ 25,000	$ 25,000
14	Channel Excavation	C.Y.	11,757	$ 60	$ 705,420
15	Culvert Concrete	C.Y.	6,595	$ 400	$ 2,638,000
16	Culvert Steel	Pounds	1,641,760	$ 0.72	$ 1,182,067
17	Minor Concrete (Sidewalk)	S.F.	720	$ 10	$ 7,200
18	Minor Concrete (S1-6 Curb)	L.F.	288	$ 35	$ 10,080
19	Minor Concrete (Median)	S.F.	144	$ 10	$ 1,440
20	Asphalt Concrete (Street, 6" section, 16" AB included)	Tons	183	$ 170	$ 31,110
21	Asphalt Concrete (Parking Lot, 4" section, 6" AB)	Tons	201	$ 140	$ 28,140

OTHER COSTS:

Design Engineering	$ 525,000	Construction Subtotal	$ 4,970,107
Construction Engineering (10% of Construction Contract)	$ 497,011	Construction Escalation (0% due to current recession.)	$ 4,970,107
Geotechnical Report	$ -		
Real Property Labor	$ -	OTHER COSTS	$ 1,022,011
R/W Acquisition (Excluded from Contringency)	$ -	SUBTOTAL	$ 5,992,118
Environmental (Included in the overall project costs.)	$ -	CONTINGENCY [1]	$ 994,021
Total OTHER COSTS	$ 1,022,011	TOTAL	$ 6,986,139

[1] CONTINGENCY is 20% of Construction Subtotal

See attached sheets for additional assumptions and calculations.

Does not include environmental investigation and remediation

ROUNDED TOTAL $ 6,987,000

Contra Costa County Flood Control & Water Conservation District

Estimate No. 9

Flood Control Engineering — Preliminary Cost Estimate

Project Name: West Antioch Creek at 10th Street

Project Number: WO# 8399

Project Description: Phased Installation of Reinforced Concrete Box Culverts -- **Four 14' x 7' and One 8' x 7' Caltrans Standard Box Culverts, 620' long**

Estimate Date: 3-May-10

Project Location: 10th and O Streets, Antioch, CA

Revision No.

Prepared by: Carl J. Roner

Revision Date:

Est. Const. Year: 2010

Equivalent to Four 16' x 7' Nonstandard Box Culverts

No.	Description	Quantity	Units	Unit Cost	Total
1	Prepare Water Pollution Control Program	L.S.	1	$ 5,000	$ 5,000
2	Water Pollution Control Program	L.S.	1	$ 10,000	$ 10,000
3	Water Control	L.S.	1	$ 50,000	$ 50,000
4	Temporary Fence	L.F.	1,400	$ 16	$ 22,400
5	Clearing and Grubbing	L.S.	1	$ 50,000	$ 50,000
6	Traffic Control	L.S.	1	$ 8,000	$ 8,000
7	Mobilization	L.S.	1	$ 25,000	$ 25,000
8	Construction Area Signs	L.S.	1	$ 3,000	$ 3,000
9	Wing Walls	EA	2	$ 20,000	$ 40,000
10	Rip Rap Protection (1/4 Ton Rock, 25' downstream)	Tons	600	$ 130	$ 78,000
11	Fine Grading at Transition	EA	2	$ 5,000	$ 10,000
12	Utility Relocation	L.S.	1	$ 50,000	$ 50,000
13	Remove and Reconstruct Car Port	L.S.	1	$ 25,000	$ 25,000
14	Channel Excavation	C.Y.	13,230	$ 60	$ 793,800
15	Culvert Concrete	C.Y.	7,431	$ 400	$ 2,972,400
16	Culvert Steel	Pounds	1,858,760	$ 0.72	$ 1,338,307
17	Minor Concrete (Sidewalk)	S.F.	800	$ 10	$ 8,000
18	Minor Concrete (S1-6 Curb)	L.F.	320	$ 35	$ 11,200
19	Minor Concrete (Median)	S.F.	160	$ 10	$ 1,600
20	Asphalt Concrete (Street, 6" section, 16" AB included)	Tons	203	$ 170	$ 34,510
21	Asphalt Concrete (Parking Lot, 4" section, 6" AB)	Tons	201	$ 140	$ 28,140

OTHER COSTS:

Design Engineering	$ 525,000	Construction Subtotal	$ 5,564,357
Construction Engineering (10% of Construction Contract)	$ 556,436	Construction Escalation (0% due to current recession.)	$ 5,564,357
Geotechnical Report	$ -		
Real Property Labor	$ -	OTHER COSTS	$ 1,081,436
R/W Acquisition (Excluded from Contringency)	$ -	SUBTOTAL	$ 6,645,793
Environmental (Included in the overall project costs.)	$ -	CONTINGENCY [1]	$ 1,112,871
Total OTHER COSTS	$ 1,081,436	TOTAL	$ 7,758,664

[1] CONTINGENCY is 20% of Construction Subtotal

See attached sheets for additional assumptions and calculations.

Does not include environmental investigation and remediation

ROUNDED TOTAL $ 7,759,000

Contra Costa County Flood Control & Water Conservation District

Estimate No. 10

Flood Control Engineering — Preliminary Cost Estimate

Project Name: West Antioch Creek at 10th Street

Project Number WO# 8399

Project Description Phased Installation of Reinforced Concrete Box Culverts -- **One 16' x 7' Box Culvert, 620' long**

Estimate Date: 19-Apr-10

Project Location: 10th and O Streets, Antioch, CA

Revision No.

Prepared by: Carl J. Roner

Revision Date:

Est. Const. Year: 2010

No.	Description	Quantity	Units	Unit Cost	Total
1	Prepare Water Pollution Control Program	L.S.	1	$ 5,000.00	$ 5,000
2	Water Pollution Control Program	L.S.	1	$ 10,000.00	$ 10,000
3	Water Control	L.S.	1	$ 50,000.00	$ 50,000
4	Temporary Fence	L.F.	1,400	$ 16.00	$ 22,400
5	Clearing and Grubbing	L.S.	1	$ 50,000.00	$ 50,000
6	Traffic Control	L.S.	1	$ 8,000.00	$ 8,000
7	Mobilization	L.S.	1	$ 25,000.00	$ 25,000
8	Construction Area Signs	L.S.	1	$ 3,000.00	$ 3,000
9	Wing Walls	EA	2	$ 20,000.00	$ 40,000
10	Rip Rap Protection (1/4 Ton Rock, 25' downstream)	Tons	150	$ 130.00	$ 19,500
11	Fine Grading at Transition	EA	2	$ 5,000.00	$ 10,000
12	Utility Relocation	L.S.	1	$ 50,000.00	$ 50,000
13	Remove and Reconstruct Car Port	L.S.	1	$ 25,000.00	$ 25,000
14	Channel Excavation	C.Y.	4,410	$ 60.00	$ 264,600
15	Culvert Concrete	C.Y.	1,917	$ 660.00	$ 1,265,220
16	Culvert Steel	Pounds	481,740	$ 0.95	$ 457,653
17	Minor Concrete (Sidewalk)	S.F.	320	$ 10.00	$ 3,200
18	Minor Concrete (S1-6 Curb)	L.F.	128	$ 35.00	$ 4,480
19	Minor Concrete (Median)	S.F.	160	$ 10.00	$ 1,600
20	Asphalt Concrete (Street, 6" section, 16" AB included)	Tons	82	$ 200.00	$ 16,400
21	Asphalt Concrete (Parking Lot, 4" section, 6" AB)	Tons	201	$ 150	$ 30,150

OTHER COSTS:

Design Engineering	$ 600,000	Construction Subtotal	$ 2,361,203
Construction Engineering (10% of Construction Contract)	$ 236,120	Construction Escalation (0% due to current recession.)	$ 2,361,203
Geotechnical Report	$ -		
Real Property Labor	$ -	OTHER COSTS	$ 836,120
R/W Acquisition (Excluded from Contringency)	$ -	SUBTOTAL	$ 3,197,323
Environmental (Included in the overall project costs.)	$ -	CONTINGENCY [1]	$ 472,241
Total OTHER COSTS	$ 836,120	TOTAL	$ 3,669,564

[1] CONTINGENCY is 20% of Construction Subtotal

See attached sheets for additional assumptions and calculations.

Does not include environmental investigation and remediation

ROUNDED TOTAL $ 3,670,000

Contra Costa County Flood Control & Water Conservation District

Estimate No. 11

Flood Control Engineering — Preliminary Cost Estimate

Project Name: West Antioch Creek at 10th Street

Project Number: WO# 8399

Project Description: Phased Installation of Reinforced Concrete Box Culverts -- **Two 16' x 7' Box Culverts, 620' long**

Estimate Date: 19-Apr-10

Project Location: 10th and O Streets, Antioch, CA

Revision No.

Prepared by: Carl J. Roner

Revision Date:

Est. Const. Year: 2010

No.	Description	Quantity	Units	Unit Cost	Total
1	Prepare Water Pollution Control Program	L.S.	1	5,000.00	$ 5,000
2	Water Pollution Control Program	L.S.	1	10,000.00	$ 10,000
3	Water Control	L.S.	1	50,000.00	$ 50,000
4	Temporary Fence	L.F.	1,400	16.00	$ 22,400
5	Clearing and Grubbing	L.S.	1	50,000.00	$ 50,000
6	Traffic Control	L.S.	1	8,000.00	$ 8,000
7	Mobilization	L.S.	1	25,000.00	$ 25,000
8	Construction Area Signs	L.S.	1	3,000.00	$ 3,000
9	Wing Walls	EA	2	20,000.00	$ 40,000
10	Rip Rap Protection (1/4 Ton Rock, 25' downstream)	Tons	300	130.00	$ 39,000
11	Fine Grading at Transition	EA	2	5,000.00	$ 10,000
12	Utility Relocation	L.S.	1	50,000.00	$ 50,000
13	Remove and Reconstruct Car Port	L.S.	1	25,000.00	$ 25,000
14	Channel Excavation	C.Y.	7,350	60.00	$ 441,000
15	Culvert Concrete	C.Y.	3,725	565.00	$ 2,104,625
16	Culvert Steel	Pounds	963,480	0.76	$ 732,245
17	Minor Concrete (Sidewalk)	S.F.	480	10.00	$ 4,800
18	Minor Concrete (S1-6 Curb)	L.F.	192	35.00	$ 6,720
19	Minor Concrete (Median)	S.F.	240	10.00	$ 2,400
20	Asphalt Concrete (Street, 6" section, 16" AB included)	Tons	123	200.00	$ 24,600
21	Asphalt Concrete (Parking Lot, 4" section, 6" AB)	Tons	201	150.00	$ 30,150

OTHER COSTS:

Design Engineering	$ 600,000	Construction Subtotal	$ 3,683,940
Construction Engineering (10% of Construction Contract)	$ 368,394	Construction Escalation (0% due to current recession.)	$ 3,683,940
Geotechnical Report	$ -		
Real Property Labor	$ -	OTHER COSTS	$ 968,394
R/W Acquisition (Excluded from Contringency)	$ -	SUBTOTAL	$ 4,652,334
Environmental (Included in the overall project costs.)	$ -	CONTINGENCY [1]	$ 736,788
Total OTHER COSTS	$ 968,394	TOTAL	$ 5,389,122

[1] CONTINGENCY is 20% of Construction Subtotal

See attached sheets for additional assumptions and calculations.

Does not include environmental investigation and remediation

ROUNDED TOTAL $ 5,390,000

Contra Costa County Flood Control & Water Conservation District

Estimate No. 12

Flood Control Engineering — Preliminary Cost Estimate

Project Name: West Antioch Creek at 10th Street

Project Number: WO# 8399

Project Description: Phased Installation of Reinforced Concrete Box Culverts -- **Three 16' x 7' Box Culverts, 620' long**

Estimate Date: 19-Apr-10

Project Location: 10th and O Streets, Antioch, CA

Revision No.

Prepared by: Carl J. Roner

Revision Date:

Est. Const. Year: 2010

No.	Description	Quantity	Units	Unit Cost	Total
1	Prepare Water Pollution Control Program	L.S.	1	5,000.00	$ 5,000
2	Water Pollution Control Program	L.S.	1	10,000.00	$ 10,000
3	Water Control	L.S.	1	50,000.00	$ 50,000
4	Temporary Fence	L.F.	1,400	16.00	$ 22,400
5	Clearing and Grubbing	L.S.	1	50,000.00	$ 50,000
6	Traffic Control	L.S.	1	8,000.00	$ 8,000
7	Mobilization	L.S.	1	25,000.00	$ 25,000
8	Construction Area Signs	L.S.	1	3,000.00	$ 3,000
9	Wing Walls	EA	2	20,000.00	$ 40,000
10	Rip Rap Protection (1/4 Ton Rock, 25' downstream)	Tons	450	130.00	$ 58,500
11	Fine Grading at Transition	EA	2	5,000.00	$ 10,000
12	Utility Relocation	L.S.	1	50,000.00	$ 50,000
13	Remove and Reconstruct Car Port	L.S.	1	25,000.00	$ 25,000
14	Channel Excavation	C.Y.	10,290	60.00	$ 617,400
15	Culvert Concrete	C.Y.	5,587	469.00	$ 2,620,303
16	Culvert Steel	Pounds	1,445,220	0.72	$ 1,040,558
17	Minor Concrete (Sidewalk)	S.F.	640	10.00	$ 6,400
18	Minor Concrete (S1-6 Curb)	L.F.	256	35.00	$ 8,960
19	Minor Concrete (Median)	S.F.	320	10.00	$ 3,200
20	Asphalt Concrete (Street, 6" section, 16" AB included)	Tons	163	170.00	$ 27,710
21	Asphalt Concrete (Parking Lot, 4" section, 6" AB)	Tons	201	140.00	$ 28,140

OTHER COSTS:

Design Engineering	$ 600,000	Construction Subtotal	$ 4,709,571
Construction Engineering (10% of Construction Contract)	$ 470,957	Construction Escalation (0% due to current recession.)	$ 4,709,571
Geotechnical Report	$ -		
Real Property Labor	$ -	OTHER COSTS	$ 1,070,957
R/W Acquisition (Excluded from Contringency)	$ -	SUBTOTAL	$ 5,780,529
Environmental (Included in the overall project costs.)	$ -	CONTINGENCY [1]	$ 941,914
Total OTHER COSTS	$ 1,070,957	TOTAL	$ 6,722,443

[1] CONTINGENCY is 20% of Construction Subtotal

See attached sheets for additional assumptions and calculations.

Does not include environmental investigation and remediation

ROUNDED TOTAL $ 6,723,000

Contra Costa County Flood Control & Water Conservation District

Estimate No. 13

Flood Control Engineering — Preliminary Cost Estimate

Project Name: West Antioch Creek at 10th Street

Project Number: WO# 8399

Project Description: Phased Installation of Reinforced Concrete Box Culverts -- **Four 16' x 7' Box Culverts, 620' long**

Estimate Date: 19-Apr-10

Project Location: 10th and O Streets, Antioch, CA

Revision No.

Prepared by: Carl J. Roner

Revision Date:

Est. Const. Year: 2010

No.	Description	Quantity	Units	Unit Cost	Total
1	Prepare Water Pollution Control Program	L.S.	1	5,000.00	$ 5,000
2	Water Pollution Control Program	L.S.	1	10,000.00	$ 10,000
3	Water Control	L.S.	1	50,000.00	$ 50,000
4	Temporary Fence	L.F.	1,400	16.00	$ 22,400
5	Clearing and Grubbing	L.S.	1	50,000.00	$ 50,000
6	Traffic Control	L.S.	1	8,000.00	$ 8,000
7	Mobilization	L.S.	1	25,000.00	$ 25,000
8	Construction Area Signs	L.S.	1	3,000.00	$ 3,000
9	Wing Walls	EA	2	20,000.00	$ 40,000
10	Rip Rap Protection (1/4 Ton Rock, 25' downstream)	Tons	600	130.00	$ 78,000
11	Fine Grading at Transition	EA	2	5,000.00	$ 10,000
12	Utility Relocation	L.S.	1	50,000.00	$ 50,000
13	Remove and Reconstruct Car Port	L.S.	1	25,000.00	$ 25,000
14	Channel Excavation	C.Y.	13,230	60.00	$ 793,800
15	Culvert Concrete	C.Y.	7,450	400.00	$ 2,980,000
16	Culvert Steel	Pounds	1,926,960	0.72	$ 1,387,411
17	Minor Concrete (Sidewalk)	S.F.	800	10.00	$ 8,000
18	Minor Concrete (S1-6 Curb)	L.F.	320	35.00	$ 11,200
19	Minor Concrete (Median)	S.F.	400	10.00	$ 4,000
20	Asphalt Concrete (Street, 6" section, 16" AB included)	Tons	203	170.00	$ 34,510
21	Asphalt Concrete (Parking Lot, 4" section, 6" AB)	Tons	201	140.00	$ 28,140

OTHER COSTS:

Design Engineering	$ 600,000	Construction Subtotal	$ 5,623,461
Construction Engineering (10% of Construction Contract)	$ 562,346	Construction Escalation (0% due to current recession.)	$ 5,623,461
Geotechnical Report	$ -		
Real Property Labor	$ -	OTHER COSTS	$ 1,162,346
R/W Acquisition (Excluded from Contringency)	$ -	SUBTOTAL	$ 6,785,807
Environmental (Included in the overall project costs.)	$ -	CONTINGENCY [1]	$ 1,124,692
Total OTHER COSTS	$ 1,162,346	TOTAL	$ 7,910,500

[1] CONTINGENCY is 20% of Construction Subtotal

See attached sheets for additional assumptions and calculations.

Does not include environmental investigation and remediation

ROUNDED TOTAL $ 7,911,000

Contra Costa County Flood Control & Water Conservation District

Estimate No. 14

Flood Control Engineering — Preliminary Cost Estimate

Project Name: West Antioch Creek at 10th Street

Project Number: WO# 8399

Project Description: Phased Installation of Reinforced Concrete Box Culverts -- Three 14' x 7' , Caltrans Standard Box Culverts, 402' long, 218' of channel

Estimate Date: 4-May-10

Project Location: 10th and O Streets, Antioch, CA

Revision No.

Prepared by: Carl J. Roner

Revision Date:

Est. Const. Year: 2010

No.	Description	Quantity	Units	Unit Cost	Total
1	Prepare Water Pollution Control Program	L.S.	1	$ 5,000	$ 5,000
2	Water Pollution Control Program	L.S.	1	$ 10,000	$ 10,000
3	Water Control	L.S.	1	$ 50,000	$ 50,000
4	Temporary Fence	L.F.	1,400	$ 16	$ 22,400
5	Clearing and Grubbing	L.S.	1	$ 50,000	$ 50,000
6	Traffic Control	L.S.	1	$ 8,000	$ 8,000
7	Mobilization	L.S.	1	$ 25,000	$ 25,000
8	Construction Area Signs	L.S.	1	$ 3,000	$ 3,000
9	Wing Walls	EA	2	$ 20,000	$ 40,000
10	Rip Rap Protection (1/4 Ton Rock, 25' downstream)	Tons	394	$ 130	$ 51,220
11	Fine Grading at Transition	EA	2	$ 5,000	$ 10,000
12	Utility Relocation	L.S.	1	$ 50,000	$ 50,000
13	Remove and Reconstruct Car Port	L.S.	1	$ 25,000	$ 25,000
14	Channel Excavation (for channel)	C.Y.	440	$ 30	$ 13,200
15	Channel Excavation (for culverts)	C.Y.	5,956	$ 60	$ 357,360
16	Culvert Concrete	C.Y.	3,209	$ 400	$ 1,283,600
17	Culvert Steel	Pounds	798,372	$ 0.72	$ 574,828
18	Minor Concrete (Sidewalk)	S.F.	580	$ 10	$ 5,800
19	Minor Concrete (S1-6 Curb)	L.F.	232	$ 35	$ 8,120
20	Minor Concrete (Median)	S.F.	116	$ 10	$ 1,160
21	Asphalt Concrete (Street, 6" section, 16" AB included)	Tons	147	$ 170	$ 24,990
22	Asphalt Concrete (Parking Lot, 4" section, 6" AB)	Tons	130	$ 140	$ 18,200

OTHER COSTS:

Design Engineering	$ 525,000	Construction Subtotal	$ 2,636,878
Construction Engineering (10% of Construction Contract)	$ 263,688	Construction Escalation (0% due to current recession.)	$ 2,636,878
Geotechnical Report	$ -		
Real Property Labor	$ -	OTHER COSTS	$ 788,688
R/W Acquisition (Excluded from Contringency)	$ -	SUBTOTAL	$ 3,425,566
Environmental (Included in the overall project costs.)	$ -	CONTINGENCY [1]	$ 527,376
Total OTHER COSTS	$ 788,688	TOTAL	$ 3,952,941

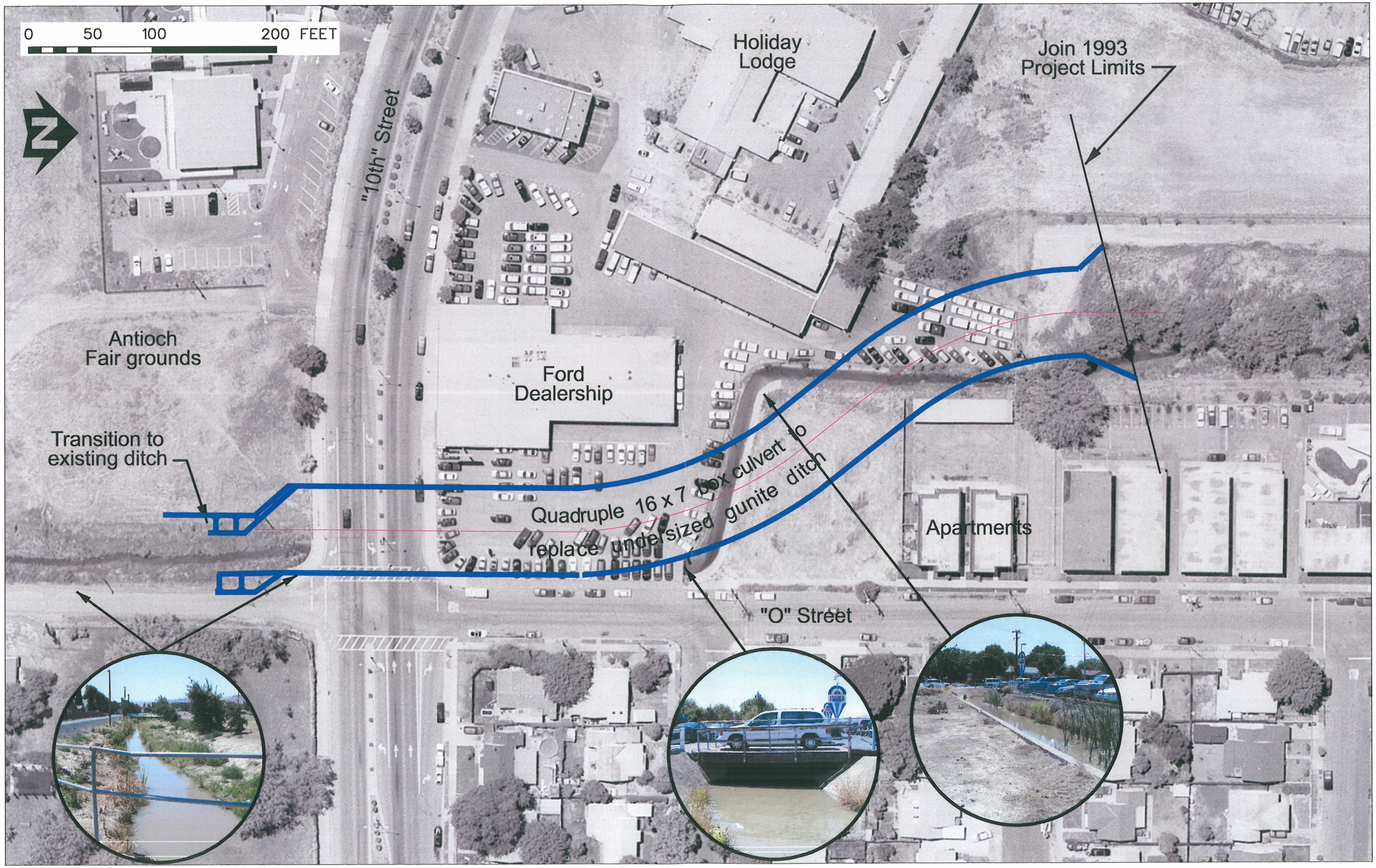
[1] CONTINGENCY is 20% of Construction Subtotal

See attached sheets for additional assumptions and calculations.

Does not include environmental investigation and remediation

ROUNDED TOTAL $ 3,953,000

West Antioch Creek Channel Improvement Project – Preliminary Plan and Typical Sections (2010)



Drainage Area 55 - Existing Conditions & Proposed Improvements to West Antioch Creek

PREPARED BY:
CONTRA COSTA COUNTY
PUBLIC WORKS DEPARTMENT
COMPUTER SERVICES - MAPPING SCIENCES SECTION
255 GLACIER DRIVE
MARTINEZ, CALIFORNIA 94553

Orthophoto
Date Of Photography May 2000
Original ortho photography mapped at 1"400' and 1"=200' scale with a 10' contour interval
Accuracy is to National Mapping Accuracy Standards

G.I.S. Disclaimer
No Geographic Information System program software was used to produce this map.

DATE : 12-20-2006 FILENAME : DA55_wantcrk.dgn BY : S. Yu PLOT DATE : BY :